MBTA GREEN LINE EXTENSION DESIGN-BUILD PROJECT

CONTRACT #E22CN07

TECHNICAL PROPOSAL

PART 4: TECHNICAL SOLUTIONS

SUBMITTED BY:
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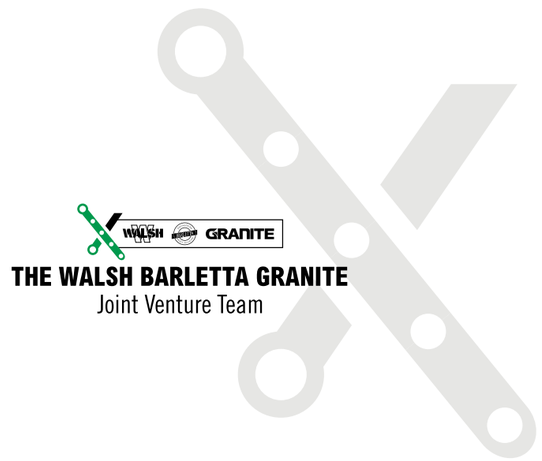
THE WALSH BARLETTA GRANITE
Joint Venture Team

ELECTRONIC

TECHNICAL PROPOSAL: PART 4
TECHNICAL SOLUTIONS



THE WALSH BARLETTA GRANITE
Joint Venture Team

Part 4
TECHNICAL SOLUTIONS

The Green Line Extension will be a vital link for the neighborhoods of Somerville, Medford, Cambridge, and the greater Boston area. WBG's conceptual design provides for the full Project scope as determined by a thorough review of the contract documents, knowledge from designing and constructing various projects for the MBTA, and familiarization with the Project site. We developed our design using all governing regulations and best practices, optimized with innovative concepts to deliver effective Project solutions.

ATC 3

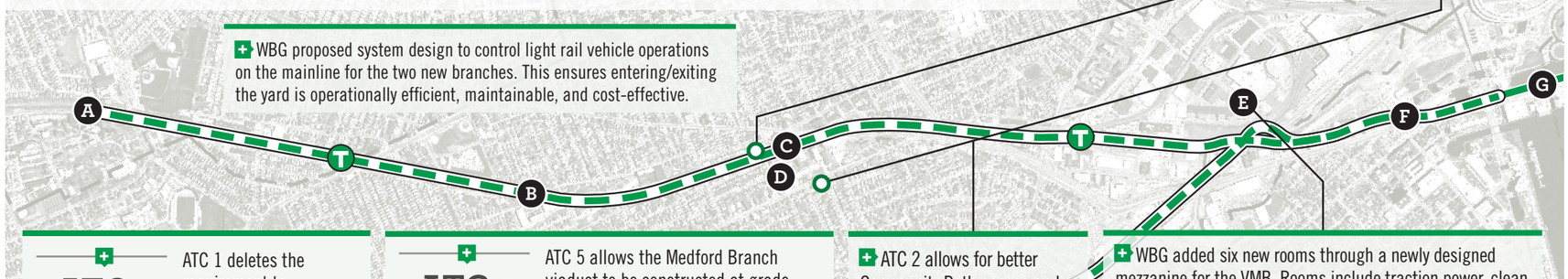
Replacement of School Street Bridge

ATC 3 replaces the existing School Street bridge with a new, single-span structure over the Green Line and NH commuter rail tracks.

ATC 2

Walnut Community Path At Grade

ATC 2 eliminates the Community Path underpass at Walnut Street by placing the path at street level.



WBG proposed system design to control light rail vehicle operations on the mainline for the two new branches. This ensures entering/exiting the yard is operationally efficient, maintainable, and cost-effective.

ATC 1

Eliminate Heated Enclosures for Winter Concrete

ATC 1 deletes the requirement to construct and maintain heated enclosures, as detailed in our revised Specification 03300.

ATC 5

Viaduct EPS Fill Alternative

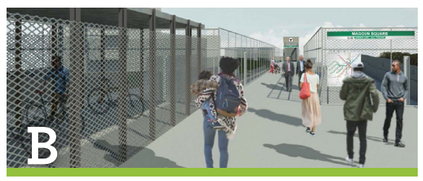
ATC 5 allows the Medford Branch viaduct to be constructed at grade, supported on a ballast layer and a concrete distribution slab placed on EPS block embankments. This ATC improves the schedule and reduces vibration and construction impacts.

ATC 2 allows for better Community Path access and connectivity, while eliminating a covered underpass and associated safety and maintenance concerns.

WBG added six new rooms through a newly designed mezzanine for the VMB. Rooms include traction power, clean agent, telephone, mechanical, UPS, and electrical rooms. The VMB will be constructed using a top-down construction method to reduce the VMB construction duration.

GREEN LINE EXTENSION TECHNICAL SOLUTION HIGHLIGHTS

College Avenue Station. Improvements, including secure walkways, will benefit both the community of Medford and the students and staff of Tufts University.

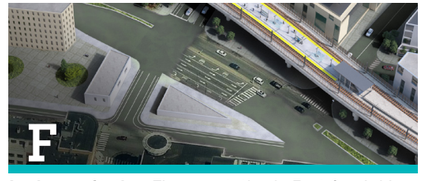


Magoun Square Station. The new station will serve the communities of Somerville for the Green Line "D" Branch and will include accessible accommodation areas.

Gilman Square Station. Located at Medford Street and Pearl Street in Somerville, this station will include historical interpretive displays.

Walnut Street Community Path. WBG optimizes the Walnut Street Community Path underpass by placing the path at street level.

Vehicle Maintenance Facility. WBG will design and construct a durable facility to store, operate, and maintain the existing fleet and newly procured light rail vehicles for the MBTA. WBG enhanced the overall building design to include six new rooms for mechanical and electrical equipment and several new doors for emergency egress and equipment room access.



Lechmere Station. The new station in East Cambridge will reduce train overcrowding found in Boston's downtown stations and will include various ADA compliant accessible walkways.

Lechmere Viaduct. Located in East Cambridge, the double track structure will support eastbound and westbound tracks of the Medford Branch alignment.

ACRONYM DEFINITIONS

To assist in providing comprehensive technical solutions, WBG lists definitions for all acronyms found within Technical Proposal Part 4.

ABS: Automatic Block Signaling
AC: Access Control System
ASD: Allowable Stress Design
AVI: Automatic Vehicle Identification
BCIL: Boston Center for Independent Living
BMS: Building Mgmt. System
CCB: Code Control Box
CCTV: Closed-Circuit Television
CDWM: Construction and Demolition Waste Mgmt. Plan
CEPP: Comprehensive Environmental Protection Program
CIH: Central Instrument Houses
CIL: Certifiable Items List
CMP: Configuration Mgmt. Plan
CPLC: Communications Programmable Logic Controllers
CPT: Core Penetration Testing
CPTED: Crime Prevention Through Environmental Design
CWR: Continuously Welded Rail
DMP: Deformation Monitor Point
EACS: Electronic Access Control System
ECB: Emergency Call Box
EDR: Electrical Distribution Room
EMMP: Excavated Materials Mgmt. Plan
EMP: Environmental Mitigation and Monitoring Plan
FONSI: Finding of No Significant Impact
FTA: Federal Transit Administration
GMP: Groundwater Mgmt. Plan
HMCS: Hub Monitoring and Control System
HT: Heat Treated
HV: Heating and Ventilating
IAQ: Indoor Air Quality
IECC: International Energy Conservation Code
IESNA: Illuminating Engineering Society of North America
ISTP: Integrated System Test Plan
IW: Industrial Waste
LRFD: Load and Resistance Factor Design
LRTMSS: Light Rail Transit Track Maintenance and Safety Standards
LRV: Light Rail Vehicle
MCP: Massachusetts Contingency Plan
MEC: Massachusetts Electrical Code
MEP: Mechanical/Electrical/Plumbing
MSBC: Massachusetts State Building Code
NRCS: Natural Resources Conservation Service
NVMP: Noise and Vibration Mitigation Plan
NVPCL: Non-Vital PLC
OC: On Center
OCC: Operations Control Center
OCS: Overhead Contact System
PA: Public Address
PA/TPIS: Public Address/Transit Passenger Information System
PoE: Power Over Ethernet
PSIM: Physical Security Information System
QMP: Quality Mgmt. Plan
RC: Running Clearance
RFC: Release for Construction
RMP: Requirements Mgmt. Plan
PTC: Positive Train Control
RTN: Release Tracking Numbers
RVTM: Requirements Verification Traceability Matrix
SCADA: Supervisory Control and Data Acquisition
SCU: Station Control Unit
SEMP: Systems Engineering Mgmt. Plan
SIMP: System Integration Mgmt. Plan
STCS: Signaling and Train Control System
SWAN: Security Wide Area Network
SWPPP: Storm Water Pollution Prevention Plan
TMDL: Total Maximum Daily Load
TOM: Train Operations Model
TP: Traction Power System
TPIS: Transit Passenger Information System
TPSS: Traction Power Substations
TWC: Train-to-Wayside Communications
UPS: Uninterruptible Power Supply
VAV: Variable Air Volume
V&V: Verification and Validation
VMB: Vehicle Maintenance Building
VMF: Vehicle Maintenance Facility
VMS: Variable Message Signs
VMIS: Vital Microprocessor interlocking Systems
VoIP: Voice Over Internet Protocol
VPN: Virtual Private Networks
WAN: Wide Area Network

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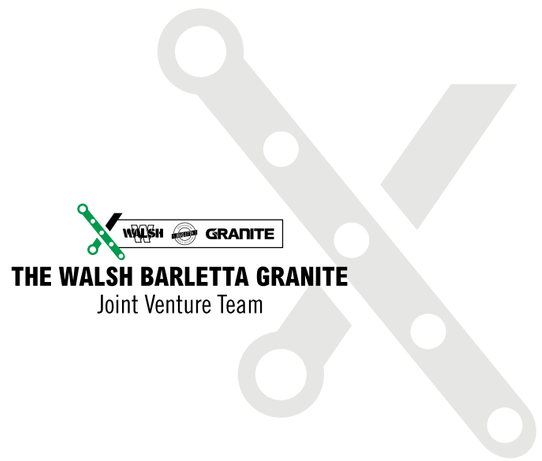
SYSTEMS AND SYSTEM INTEGRATION



THE WALSH BARLETTA GRANITE
Joint Venture Team

4.1 Systems and System Integration

WBG brings a systems design and construction team to the GLX Project with nationwide experience in design-build light rail transit, and long-standing relationships with the top systems suppliers. Our approach to safety and systems assurance will use the same processes and plans described in Section 3.3 and will be managed by Systems Integration/Testing & Commissioning Manager, Ed McDonald. Using this systems engineering approach and a series of plans to execute it, we will verify all project requirements have been properly identified, integrated, and incorporated into the final GLX Project turned over to the MBTA.

A. LIGHT RAIL TRANSIT SYSTEMS

Design Methodology and Approach

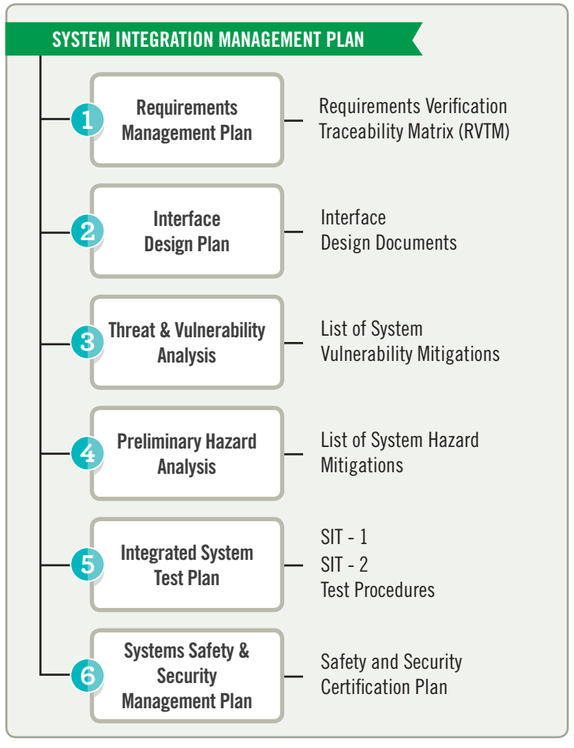
WBG's design team, under the guidance of Design Manager Michael Kennedy, will develop a systems engineering approach to manage requirements, ensure compliance, and attain safety and security goals for the GLX Project. This approach will be based on the guidelines established in the INCOSE Systems Handbook v3.2.2 and/or ISO/IEC 15288 "Systems Engineering – Systems Life Cycle Processes," and uses a series of plans shown in Figure 4.1-1. We will incorporate these recommended practices into the management, design, construction, and testing phases of the Project. We will also rely on industry best practice, proven methodologies, and the experience of our team.

System Engineering Management Plan

The Systems Engineering Management Plan (SEMP) will be the responsibility of Systems Integration/Testing & Commissioning Manager, Ed McDonald. It is the top-level systems document that will describe our entire process, the organization, and the rules for our team, and layout the roadmap to meeting the MBTA's requirements. The SEMP has several key components, the most important of which is the System Integration Management Plan (SIMP). The SIMP is described in more detail in Section 3.3 of our Technical Proposal and is our core guide for requirements, design, analyses, and testing, showing the MBTA that our team performed the job correctly. All the plans contained in the SIMP are integrally linked and have critical steps for us to complete and track throughout the project.

Beyond this, the SEMP provides guidelines for the project management team to support the process, describes the tools (generally software) that will be used to manage the amount of data that must be collected and linked, and provides the team the configuration control guidelines and rules required to manage contract requirements through the life cycle of the Project. The SEMP is written and implemented under the direction of the Systems Integration Manager and is configured to the traditional and special requirements generated by the GLX Project.

Figure 4.1-1 Relationship of Systems Management Plans.



The SEMP will set out a program that will guide the entire WBG team in a unified direction by:

- Providing a structured and auditable approach to attaining requirements, managing interfaces, and controlling risks throughout the project life cycle
- Formalizing the processes in all stages of the Project
- Eliciting agreement between design disciplines to mitigate change and rework
- Providing a solid basis to generate test plans and commissioning procedures
- Driving development for required system manuals and training

Requirements Management Plan

Requirements are the basis from which the overall system is designed and constructed and provides the designer with the basis for determining when designs are complete and in compliance with MBTA contract requirements. Clear identification, definition, and management of requirements is essential to ensure the delivery of a functioning and compliant system. The Requirements Management Plan (RMP) will be one of the six subplans described in the SIMP.

The MBTA has established prescriptive and operational requirements, managed throughout the project from origination until completion, rather than by project activity. Failure to adhere to requirements can negatively impact the Project schedule. Therefore, WBG will manage this process to objectively prove that all work complies with the contract requirements. WBG's quality organization will be a valuable partner in this process. Inspection and verification activities provide evidence of this compliance.

We have divided the project requirements into three groups for tracking purposes. Figure 4.1-2 summarizes each group and the method for tracking the requirements to completion. The RMP process manages all requirements to compliance, whether the requirement is a "will" or "shall" in the contract documents, derived from an interface design, or an environmental restriction.

System Integration Management Plan

The SIMP links all the systems plans that are integrated or depend on each other into one overall plan. The SIMP is described in our Technical Proposal Section 3.3 in detail. The text below focuses on the testing and commissioning process.

Creation of test documentation comes from multiple sources. The major sources of input to those plans and procedures will be drawn from the following sources:

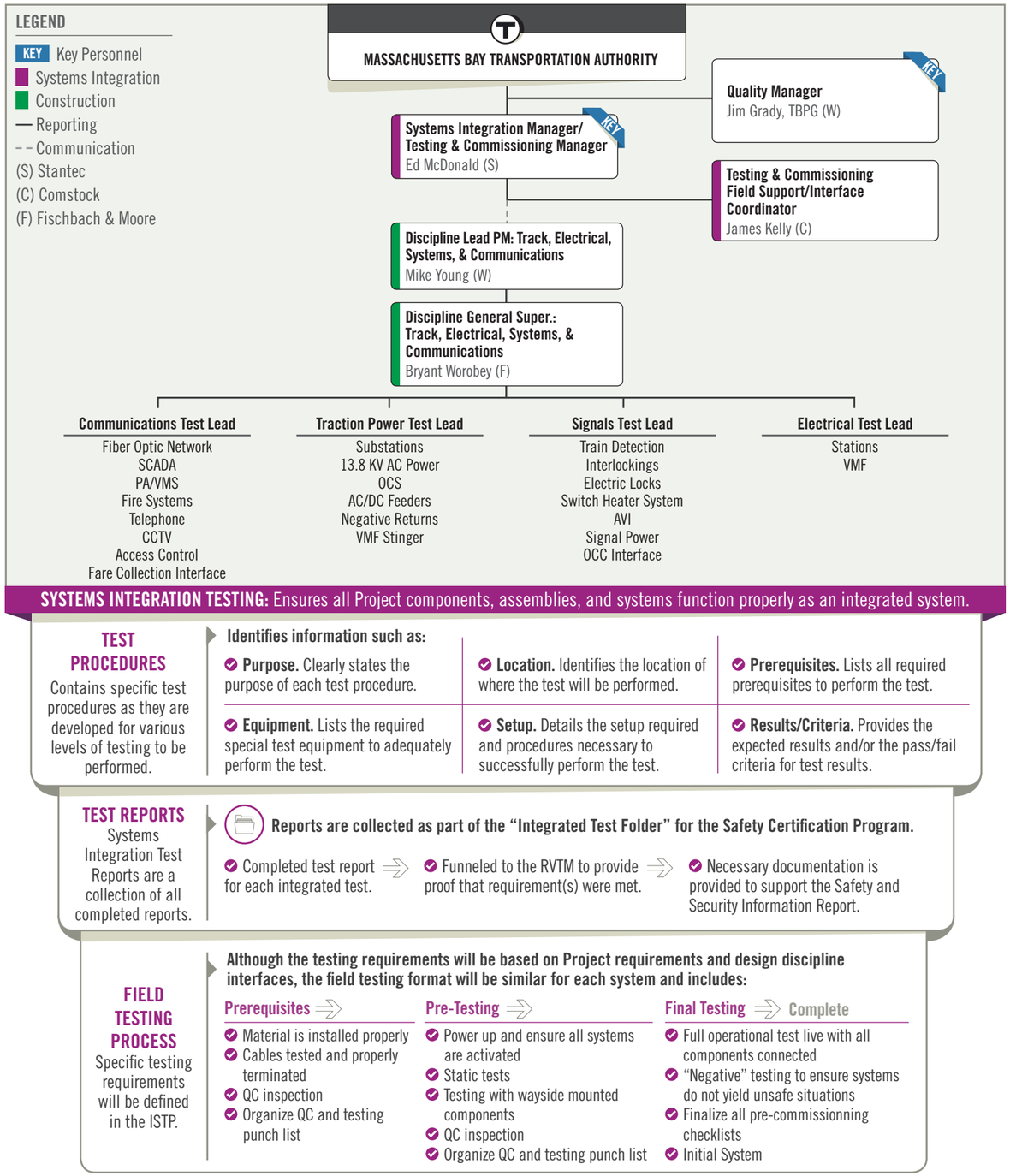
- Contract requirements
- Design interface requirements
- Construction installation verification test documentation
- Approved design drawings and specifications relating to the procurement, installation or construction of systems equipment, and facilities
- Relevant test reports for all constructed civil and systems elements (static testing)
- MBTA regulations
- FTA Guidelines for Safety and Security

Maintaining the Requirements Verification Tracking Matrix (RVTM) using the requirements management software tool ensures the necessary items for testing are compiled for each design element.

Figure 4.1-2 Project Requirements Grouped by Type.

REQUIREMENT	TRACKING METHOD
Traditional transit systems of signals and train control, communications, security, networks, traction power, and overhead contact systems	Requirements Verification Traceability Matrix (RVTM) using a requirements management software tool such as IBM DOORS. These requirements will follow the complete verification and validation process described in this section.
Safety, hazards, environmental, and system-to-system interfaces	A subset of the RVTM called the Certifiable Items List. These requirements are met when WBG provides a certificate of compliance (or completion) to the MBTA.
Remaining contract technical requirements such as track, stations, bridges, VMF, embankments, etc.	A tracking matrix using spreadsheet software. The engineer of record will establish the requirements for compliance to be satisfied at the time of Release for Construction (RFC) drawings.

Figure 4.1-3 Systems Testing Process Organization Chart


LEGEND
KEY Key Personnel
Systems Integration
Construction
Reporting
Communication
(S) Stantec
(C) Comstock
(F) Fischbach & Moore
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
Quality Manager
Jim Grady, TBPG (W)
KEY
Systems Integration Manager/ Testing & Commissioning Manager
Ed McDonald (S)
KEY
Testing & Commissioning Field Support/Interface Coordinator
James Kelly (C)
Discipline Lead PM: Track, Electrical, Systems, & Communications
Mike Young (W)
Discipline General Super.: Track, Electrical, Systems, & Communications
Bryant Worobey (F)
Communications Test Lead
Fiber Optic Network
SCADA
PA/VMS
Fire Systems
Telephone
CCTV
Access Control
Fare Collection Interface
Traction Power Test Lead
Substations
13.8 KV AC Power
OCS
AC/DC Feeders
Negative Returns
VMF Stinger
Signals Test Lead
Train Detection
Interlockings
Electric Locks
Switch Heater System
AVI
Signal Power
OCC Interface
Electrical Test Lead
Stations
VMF
SYSTEMS INTEGRATION TESTING: Ensures all Project components, assemblies, and systems function properly as an integrated system.
TEST PROCEDURES
Contains specific test procedures as they are developed for various levels of testing to be performed.
Identifies information such as:
Purpose. Clearly states the purpose of each test procedure.
Location. Identifies the location of where the test will be performed.
Prerequisites. Lists all required prerequisites to perform the test.
Equipment. Lists the required special test equipment to adequately perform the test.
Setup. Details the setup required and procedures necessary to successfully perform the test.
Results/Criteria. Provides the expected results and/or the pass/fail criteria for test results.
TEST REPORTS
Systems Integration Test Reports are a collection of all completed reports.
Reports are collected as part of the "Integrated Test Folder" for the Safety Certification Program.
Completed test report for each integrated test.
Funneled to the RVTM to provide proof that requirement(s) were met.
Necessary documentation is provided to support the Safety and Security Information Report.
FIELD TESTING PROCESS
Specific testing requirements will be defined in the ISTP.
Although the testing requirements will be based on Project requirements and design discipline interfaces, the field testing format will be similar for each system and includes:
Prerequisites
Material is installed properly
Cables tested and properly terminated
QC inspection
Organize QC and testing punch list
Pre-Testing
Power up and ensure all systems are activated
Static tests
Testing with wayside mounted components
QC inspection
Organize QC and testing punch list
Final Testing
Complete
Full operational test live with all components connected
"Negative" testing to ensure systems do not yield unsafe situations
Finalize all pre-commissionning checklists
Initial System

This continuous management of requirements simplifies creation of the testing, inspection, or simulation processes that validates the final product against the MBTA contract requirements.

Testing Organization

WBG's systems testing organization and an outline of the process it will follow are presented in Figure 4.1-3. Project requirements incorporated into the design will be verified from factory through field, and integrated testing and the results will be properly documented for the purposes of safety certification. The complete design process, inclusive of systems integration, will be coordinated with construction and testing and commissioning within the Project Schedule, based on the order the two branches will be opened to revenue service. WBG's current plan is for the Medford Branch to open first.

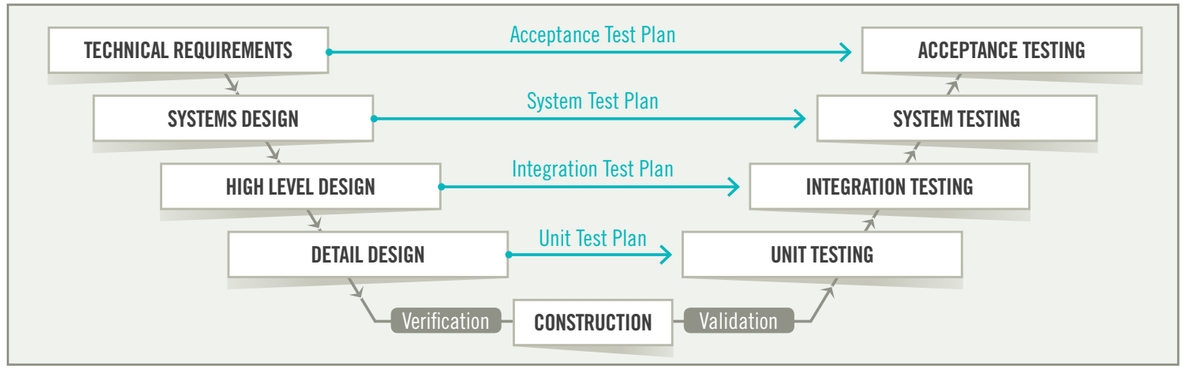
We note the MBTA's requirement to establish a temporary Project Test Center for conducting some SIT-I and all SIT-II integration tests, including dynamic testing with Green Line Light Rail Vehicles (LRVs). The Project Test Center provides the WBG testing organization the opportunity to fully verify the functionality of the newly constructed GLX without adversely affecting existing Green Line operations. Our intended full and successful use of the Project Test Center will ensure that final configuration testing of the GLX at the MBTA Operations Control Center (OCC) will go as smoothly as possible and meet our goal of safely integrating the GLX into existing MBTA operations with minimal impacts.

Verification and Validation

The Verification and Validation (V&V) process is the mechanism whereby the requirements are managed in a traceable manner that follows the development of the requirements into verifiable designs through the construction and installation process and into the inspection and testing process. All the requirements mentioned in the requirements management section will be managed through the V&V process. The process deals only with technical contract requirements. The V&V process will not involve project management, scheduling, items dealing with contract terms and conditions, or other non-technical issues. Following the systems approach, we will use a "V" model to construct our V&V program, similar what is presented in Figure 4.1-4.

The V&V process is a comprehensive documenting and tracking process, which monitors all technical requirements throughout the Project's life cycle including those that change or are deleted. Furthermore, the V&V process provides an auditable method for tracking the technical requirements to their completion. This is achieved when the contractor provides objective evidence, which verifies the design or validates the construction cycle to prove the technical requirements have been completed. The RVTM is contained within the V&V process, linking the design, test, and inspection documentation electronically to each requirement. It facilitates process requirements validation; if a requirement is applicable to multiple designs, it must be verified and validated for each of the design elements.

Figure 4.1-4 V-Model



Key Systems Suppliers and Overall Systems Integrator

Key System Suppliers

While GLX is a large project, the 4.3-mile light rail extension with a Vehicle Maintenance Facility (VMF) and a non-signaled yard falls comfortably within the capabilities of WBG's proven and available systems suppliers. Figure 4.1-5 has a summary of the WBG systems supplier experience.

Signal System: A key component of the systems, especially when it comes to the final operational testing, is the signal system. Alstom and Ansaldo STS have experience and expertise in providing LRT signal systems for projects of similar or larger size and complexity throughout North America and the world. They can design, manufacture, and test the signal system and ensure it is integrated with the remainder of the light rail system.

Figure 4.1-5 Summary of WBG Systems Supplier Experience

WBG'S EXPERIENCED SYSTEMS SUPPLIERS

WBG engaged capable and competitive systems supply firms to assemble the best team to achieve optimal Project systems.

Each firm brings nationwide expertise, including Boston experience, to successfully supply system components to the GLX Project and to the MBTA.

	SUPPLIER NAME		PROJECT HIGHLIGHTS	OWNER	LOCATION
Signals	ALSTOM	Alstom Signaling, Inc.	Hiawatha LRT	Metro Transit	Minneapolis, MN
			St. Clair and Cross County Extensions	MetroLink	St. Louis, MO
			Green, Orange, Blue Line Expansions	DART	Dallas, TX
	Ansaldo STS	Ansaldo STS	Green Line Expansion	DART	Dallas, TX
			North Shore Connector	PAAC	Pittsburgh, PA
			Crenshaw/LAX	LAMTA	Los Angeles, CA
Communications	HSQ TECHNOLOGY	HSQ Technology	Silicon Valley Berryessa Extension	VTA/BART	San Jose, CA
			U830 University Link	Sound Transit	Seattle, WA
			eBart	BART	Pittsburg/Antioch, CA
	Rockwell Collins	Rockwell Collins	AIM CTC Passenger Information System	MBTA	Boston, MA
			Central Corridor AIM CTC/SCADA/LRT Communications	Metro Transit	Minneapolis/ St. Paul, MN
			AIM CTC/SCADA/LRT Communications	Metro	Houston, TX
		Modern Communications Systems	BART Warm Springs Extension	BART	Fremont, CA
			Eagle P3 Airport Commuter Rail	RTD	Denver, CO
			Blue Line Extension	CATS	Charlotte, NC
Traction Power	POWELL	Powell Electrical Systems	Hiawatha LRT	Metro Transit	Minneapolis, MN
			Silicon Valley Berryessa Extension	VTA/BART	San Jose, CA
	ABB	ABB Inc.	TPSS Improvement Project	STM	Montreal, QC
			Eglinton Crosstown LRT Project	Metrolinx	Toronto, ON
			Evergreen Rapid Transit Line	TransLink	Vancouver, BC
	Myers Power Products, Inc.	Myers Controlled Power, LLC	Hillside/Kew Gardens TPSS Replacement	LIRR	New York, NY
			Traction Power System Upgrades	CTA	Chicago, IL
			BART Warm Springs Extension	BART	Fremont, CA
Overhead Contact System	IMPulse NC LLC	Impulse NC LLC	South Oak Cliff Corridor SOC3	DART	Dallas, TX
			Denver I-225 Project	RTD	Denver, CO
			DART Orange Line I-3	DART	Dallas, TX
	MAC Products Inc.	MAC Products	Central Mesa LRT	Valley Metro	Phoenix, AZ
			EXPO II Line	LAMTA	Los Angeles, CA
			Draper Line	UTA	Salt Lake City, UT

Communications: Communications ties the Project's systems together and has become one of the largest systems components as its capabilities and use are expanded. Several communications integrators with the necessary transit experience for the GLX Project include: HSQ Technology, Rockwell Collins (formerly ARINC), and Modern Communications Systems (formerly Rail Services Corporation). All have been involved in design-build rail transit projects and understand the high level of design integration required for a successful project and how much of that integration burden relies on their scope.

Traction Power: The traction power scope for GLX is large and diverse, including three substations, 13.8 KV AC primary power, 13.8 KV ring feeders, 13.8 KV distribution to station, and 600V DC distribution for LRT operations with 1,000 KCMIL parallel feeders and a 2,000 KCMIL supplemental negative. Powell Electrical Systems, ABB Inc., and Myers Controlled Power, LLC all have an installed footprint in North America and experience in design-build rail transit.

Overhead Contact System (OCS): WBG will use two experienced suppliers with the requisite capacity for the OCS system: Impulse NC LLC and MAC Products. Both are regularly engaged in supplying the North American market and have long experience with the WBG system design and installation team.

Overall Systems Integrator

Jacobs, as a part of the WBG team, will provide the overall systems integration for the GLX Project using their experience in LRT systems and major integration efforts. Jacobs will design all the rail systems, including track, signals, communications, traction power, catenary and facilities. Ed McDonald of Stantec is the Systems Integration Manager/Testing & Commissioning Manager. He will oversee the systems integration during design and construction to confirm the systems are designed and integrated correctly.

Jacobs and Ed both have experience on the California High Speed Rail (CHSR) system. Jacobs is the engineer of record for the design-build team for this $1.6 billion project. The CHSR is the first major civil project in the U.S. to incorporate the systems approach to design, construction and testing. Ed has served as the client representative for the largest in-process segment of the CHSR system, leading the systems integration and requirements management for the civil design. Together, Ed and Jacobs have constructed a workable requirements management system, a design integration plan with the future track and systems design, an interface design system, and a logical approach to developing test plans to validate the system. Ed's current obligations on CHSR will be completed in time for his role on GLX.

On the Staten Island Railroad Project, Ed performed as the lead signals construction manager, integrating the new signal system into a reconstruction of an existing terminal interlocking. This interlocking was under several feet of water during Hurricane Sandy. The design and construction of the entire plant incorporated features to mitigate damage in case of another storm. This project had to be performed while maintaining railroad operation and coordination with a shopping mall being installed over a portion of the track.

Design and construction interfaces can make a system extension complex. As systems integrator on the Metro Dade (Miami) heavy rail project, Ed faced the integration challenge of tying into an existing 1980s system thirty-five years after it was placed in service. This included injecting new track cut into the middle of an operating system interlocking, interfacing analog and digital track circuits, server-based office addition into a mechanical control panel based OCC and two different generations of traction power design. All systems for this $900 million project were commissioned on schedule.

B. TRAIN CONTROL SYSTEM DESIGN

Signaling and Train Control System Approach and Technical Details

The Green Line Signaling and Train Control System (S&TCS) must be extended to interface with the existing Green Line south of Lechmere Station on the East Cambridge Viaduct, north along the new Medford Branch to College Avenue Station, and west from the new Red Bridge Interlocking along the new Union Square Branch to Union Square Station. The three new yard leads also provide access to the new VMF from the two new branches. Normally, the S&TCS extends from an end-of-line station with no interlocking. For this project, the current end-of-line Lechmere Station is being replaced with a new Lechmere Station located on the new Lechmere Viaduct. The existing S&TCS will need to be modified so that Science Park Station is temporarily the end-of-the line while the new viaduct and station are built. At the conclusion of construction and testing, the new Green Line S&TCS will be cutover into the existing Green Line S&TCS.

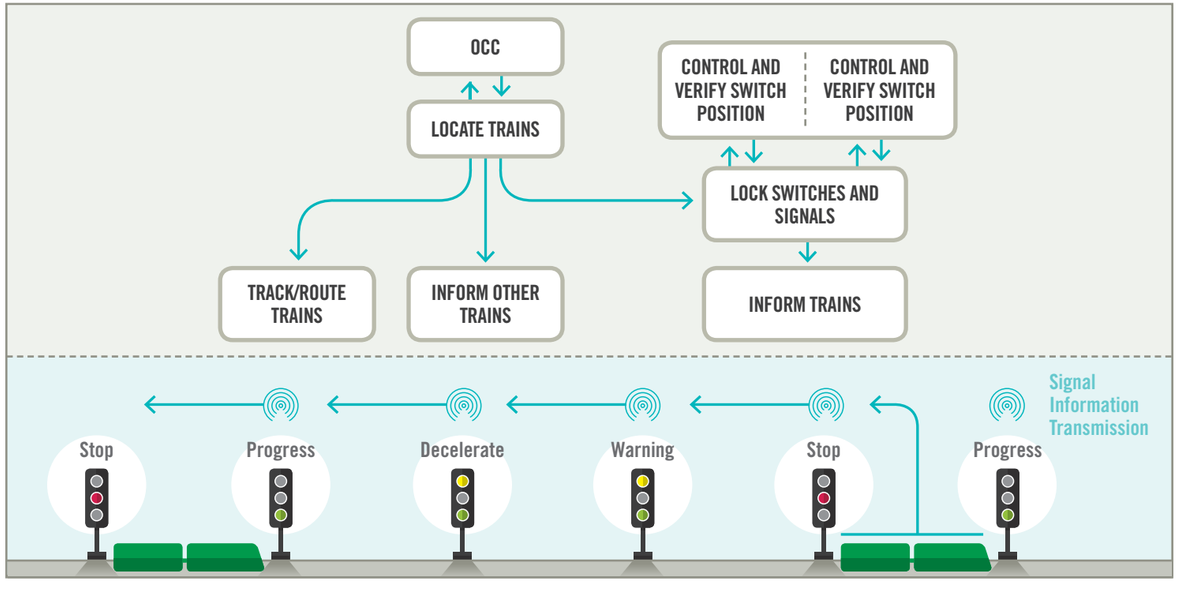
S&TCS Architecture

Proposed System

The proposed S&TCS will be consistent with the existing Green Line S&TCS using the latest underlying technology and products, with a combination of vital and non-vital processors to control and indicate the wayside signal components, as shown in Figure 4.1-6. The control equipment will be contained inside central instrument houses (CIH) located in close proximity to the stations to provide easy access for maintenance and not in wayside enclosures distributed along the right-of-way (ROW). The existing automatic vehicle identification (AVI) system will be extended to include the new interlockings and movements to the yard. Route requests will be available via the AVI system with a pushbutton backup, local control panels within the CIHs, and via remote control from the OCC. The MBTA will perform modifications to the OCC necessary to add the Green Line extension with WBG's support for testing and activation.

WBG designed the proposed system to control LRV operations on the mainline for the two new branches and entering and exiting the yard. The system is designed in a vital, fail-safe manner, with provisions for making the system operationally efficient, maintainable, cost effective, and upgradeable. The system will be configured with the following major subsystems.

Figure 4.1-6 S&TCS Architecture.



Vital Control System: Based on redundant vital microprocessor interlocking systems (VMIS), the vital signal system will provide for the safe and efficient movement of all trains. The vital system will process and execute all vital functions in accordance with the latest industry standards. The vital system will include, but not be limited to, all applicable electrical circuits and "hard" wiring redundant microprocessors, track circuits, line circuits, vital relays, and all life/safety components that make up the signal system.

The redundant VMIS units will be designed to function in a seamless "hot-standby" manner, with the offline unit taking immediate control without delay and without having to run approach times when required by a failure of the online unit. Each unit will be clearly labeled "Normal" and "Standby." In addition to the "Normal" and "Standby" units, a third cold standby unit will be rack-installed, complete with all (same count) boards specific to the VMIS units installed and running at that installation.

All inputs, outputs, timers, and logic states of variables will be logged and recorded. The capacity will allow for a minimum of 30 days of data storage before overwriting any data. The design will log all maintenance and diagnostic indications for troubleshooting purposes. Diagnostic data will be displayed in a supplier-provided development tool on the maintainer's computer to assist in the efficiency of troubleshooting and taking corrective action. All VMIS and associated apparatus will be rack-mounted inside each CIH.

Non-Vital Control System: Redundant non-vital processors will be responsible for processing all logic functions other than the vital functions performed in the VMIS units. The non-vital processors can be microprocessor-based, integrated vital and non-vital microprocessor interlocking systems, as long as the vital and non-vital programs can be separately programmed and tested without adversely affecting each other. Alternatively, a non-vital programmable logic controller (NVPLC) system similar to those the MBTA currently employs will be used in place of the integrated vital and non-vital system, if it is determined to be the optimum solution. All user control and indications of wayside devices will be through the non-vital processor systems.

The redundant non-vital systems will be configured to have the same standby capabilities as the vital system. Each non-vital processor will be able to be online and working with either vital processor, and vice versa.

Automatic Block Signaling (ABS): The S&TCS provided for GLX will be a wayside ABS system using wayside color light signals. An LRV occupying any section of track will be detected at all times by use of double rail 100 Hz AC steady-energy, phase-selective track circuits powered by redundant frequency converters located inside each CIH.

The signal block layout will interface with the existing Green Line S&TCS. The operating headways will be 5 minutes on the Medford and Union Square Branches, and 2.5 minutes on the viaduct between North Station and the new Red Bridge Interlocking, where the extension splits to the Medford and Union Square Branches. A minimum recovery buffer of 25% headway time will be provided in the design. The maximum authorized speed will be 50 mph, except where civil or block design speed restrictions are imposed.

Interlockings: To provide operational flexibility, terminal turn-back, maintenance facility access and egress, and mid-line storage and turn-back capability, six new interlockings will be constructed on the GLX Project. Interlockings will be controlled remotely from the OCC and locally from the CIH. Route requests will be manual and field automatic. Non-vital switch and exit blocking will be provided for all switches and signals to prevent establishment of routes into occupied and/or designated out-of-service zones. Field automatic will not be available with any blocks applied. When in turn-back mode, all crossovers will automatically restore to the normal position after the train has accepted the route and cleared the interlocking. Sectional release will be provided on all routes except those where operational analysis demonstrates no operational value.

The OCC will provide constant communication and receipt of indications from the field non-vital processors. In the event communication to OCC from both non-vital processors is lost for more than two minutes, the system will switch to field automatic for route requests and will stay in field automatic until communication to OCC is re-established. Once communication is restored, the system will revert to whichever route requests state it was in before the communication failure occurred.

Switch and Lock Movements: All interlocking power switch-and-lock movement layouts will be equipped with mainline dual control 110 VDC switch machines with a manual power/hand selector lever. Solid-state type switch controllers will control interlocking power switches. They will have a discrete indication of when the switch has been placed in hand operation and, while in this state, all signals with routes over the switch will display their most restrictive aspect.

Hand Throw Switch-And-Lock Movements: The hand throw switch-and-lock movements within signaled territory at Red Bridge Interlocking and just east of Magoun Square Station shall have circuit controllers to indicate switch position and be equipped with electric lock layouts.

Switch Snow Melter Heating System: Every track switch within the Project limits will be equipped with rail heating elements powered from 600 VDC traction power to provide unobstructed operation of switch points under all weather conditions. The snow melting system will consist of remotely controlled snowmelter cases, external cable, conduit, rail connections, and other miscellaneous hardware.

Automatic Vehicle Identification System: An AVI system will be integrated into the existing Green Line AVI system and will be compatible with the on board AVI equipment. AVI points will be located as needed for the routing of trains at diverging track locations, at end of line terminals, and at the locations where trains enter and exit from the yard lead tracks. The AVI system will decode the route number from the vehicle and transmit route requests to the systems based on the Code Control Box (CCB)

settings on the vehicle, and transmit vehicle and route data to the OCC for integration into system data and dispatcher display.

The AVI selection will be able to be canceled and re-routed with a field pushbutton interface. Pushbutton boxes will be provided as needed at the appropriate field locations. The pushbutton boxes will allow the operator to cancel and/or request a route.

Operations Control Center Interface

The non-vital systems will interface directly with the OCC over the OCC field network. Communications will be serial based, using a local terminal server port for each non-vital system to route the data to the OCC network. Communication protocol between the OCC and non-vital processors will be Modbus protocol with a direct communication link between the two.

Signal Data And OCC Field Networks

A redundant signal data network will be provided to manage all vital and non-vital communication between the CIHs. A separate OCC field network will be provided to manage communication between the respective CIH and OCC. Network data traffic will be segmented so that data traffic is not propagated beyond where it is useful for system functionality. All network equipment diagnostics will be available at a single designated port on the network. In addition, an indication for signal data network availability will be provided for display on the maintainer's panel.

The network will be designed with centralized management and configuration consoles. These consoles will be diversely located should the other system lose communication with the network. For the OCC field network, we will use terminal servers at all field locations to interface between the processor and the data network switch. The signal data network and OCC field network will operate on the fiber optic system.

Revenue Vehicles, Maintenance Vehicles, and VMF Yard Control

The VMF is a manually controlled facility with the mainline signaling system ending on Yard Leads 2, 3, and 4 prior to entering the yard proper. All yard switches are hand throw type, similar to Figure 4.1-7, without point detection or locking requiring routes within the yard to be manually aligned with switches visually verified as being in the correct position prior to train movement over them. While routes to and from the yard leads and the mainline are controlled by the mainline signaling system at East Somerville and McGrath Interlockings, all movement within the VMF yard and shop facilities are controlled by the yardmaster.

Using voice radio, communication among the yardmaster, the train operator, and the MBTA personnel assigned to the VMF, the train will be guided as required to storage tracks, maintenance tracks, or back to the yard leads. If routed to Shop Tracks 1 or 2, the train can move into the facility powered by the overhead contact system. If routed to Shop Tracks 3 or 4, the train will need to stop on the shop apron and lower its pantograph to allow a stinger bug stick to be attached to the pantograph to provide power to move the train into the facility. Once the train is in the shop, the maintenance personnel use manual block derails with a position indicator to establish protection.

Hi-rail maintenance vehicles within the yard present a hazard, since there are no track circuits to detect their presence. They are similar to the trains in this way and must be treated the same. The yardmaster will likewise control their movement into, within, and out of the yard will using voice radio communications.

Additionally, the yardmaster will need to manage a train's release into revenue service by a predetermined schedule or work in conjunction with the OCC to know when to release new trains into service. The yardmaster knows the consist of trains that are parked, which trains require maintenance, and which are available for dispatch.

Fall Back Operation

The proposed fall back operation of S&TCS for failure management, including degraded mode of operations and train detection and protection, includes the following:

» **Loss of controls and indications with the OCC**
- Dedicated signal communication system is based on 96-strand fiber optic cable and backed up by a second 96-strand fiber optic cable.

» **Failure of ABS track circuits and wayside signals**
- A train operator's communication with OCC mitigates track circuits failure or wayside signal failure.
- Hot standby and cold standby units back up ABS equipment centralized in CIHs.
- The automatic transfer switch inside CIH switches to a signal power supply, backed up by a standby unit substation.

» **Failure of interlocking control equipment**
- Hot standby and cold standby units back up interlocking control equipment.
- A local control from the local (emergency) control panel inside CIH backs up a loss of OCC control and indication system. The local interlocking operator acts on the dispatcher's orders using the communication system.

» **Failure of interlocking wayside equipment**
- Temporarily re-routing trains over functioning switches and manual operation of critical switches using dual control feature mitigates switch machine failure.
- The train operator's communication with OCC can mitigate wayside signal failure.
- The automatic transfer switch inside the CIH switches to a standby unit substation that mitigates interlocking power supply failure.

Yard Control Strategy and Interface

A train can enter the VMF by either requesting the route or having OCC establish the route. Trains can enter the facility from either the Union Square or Medford Branches. VMF access from the Medford Branch is only via the inbound track, due to single direction running limitations, and is accessed using AVI with a wayside pushbutton backup at the East Somerville Interlocking. This allows the train to approach Brick Bottom Interlocking, where a pushbutton will give the incoming train access to Yard Lead 2 (YL2) or Yard Lead 3 (YL3). Exiting the VMF to the Medford Branch, the train can approach the Brick Bottom Interlocking on either YL2 or YL3 and request a route via a pushbutton. Again, due to single direction running, the only available exits will be on the outbound Medford track. The request to exit will be granted based on a first-in first-out basis, with trains already on the outbound Medford Line track. AVI will announce the incoming train to the OCC.

A train departing Union Square destined for the VMF will request entry via a pushbutton at McGrath Interlocking onto Yard Lead 4 (YL4). Once the route is cleared, the train can proceed. Exiting the VMF on YL4, the train must stop and make a request by pushbutton to depart. The exit will again be established on a first-in first-out basis, with outbound trains on the Union Square Line. Once cleared, the train can move and the new train will be announced to the OCC using the AVI system.

Figure 4.1-7 Hand throw switch. WBG incorporated hand throw switches with an easy-throw handle and cube direction indicator for optimal safety.

Pushbuttons are only usable when the system is in automatic mode and all pushbuttons will have a 50-foot track circuit that the train must occupy to make the request.

Signaling and Train Control System Integration with Vehicle

The existing Green Line incorporates an AVI system as S&TCS integration with the vehicle. WBG intends to extend the existing AVI system over the new Green Line extension territory. The AVI system is a non-vital system that performs two tasks:

» Reports vehicle location to the OCC
» Request the wayside S&TCS to operate automatic switches and clear route signals at the power interlockings

The AVI system consists of two parts: car-borne equipment and wayside equipment. Every route in normal operation is represented by a unique three-digit code. At AVI key points, this code is transmitted by the car-borne equipment to the wayside equipment via an inductance loop located within the gauge of the track. The wayside equipment reports the vehicle location to the OCC and makes requests to the S&TCS as appropriate.

WBG partner Granite and key systems subcontractor LKCNT built the design-build Hiawatha Light Rail Transit System in Minneapolis, MN. The project required the design-build contract to purchase the wayside and car-borne train-to-wayside communications equipment and provide the portion to the LRV manufacturer supplying them under a separate contract. This required significant communica-

tion and coordination required to ensure the car-borne equipment provided could be integrated into the manufacture of the LRV.

Extending the existing AVI system to the GLX Project and maintaining its compatibility with multiple vehicle types will requires early communications among the systems designers, system suppliers, and either the LRV manufacturer (if the LRV is a new build) or the LRT operator (if the LRVs are part of an in service fleet). WBG will lead the AVI integration process, prioritizing early communications between all necessary and affected parties.

C. COMMUNICATION SYSTEM DESIGN

Overall Systems Topology/ Systems Connection Diagram

See Figure 4.1-9 on the following page.

Communications System Design and Functionality

The Project's communications and security systems designs are based on MBTA and industry standards and best practices, and summarized in Figure 4.1-8. These systems will interface with the existing communications and security systems at the MBTA. Using the project criteria, information from projects such as the B Line Station Consolidation, Green Line ADA, and E&M and Security Departments Task Order Contracts, and our in-depth knowledge of these MBTA systems, WBG will design communications and security systems that meet project requirements, interface to existing systems, and serve the MBTA's operational needs.

Fiber Optic Network

The GLX network will include a fiber optic, cable-based communications cable plant to support the following networks:

- **The Wide Area Network (WAN):** Provides connectivity to the OCC for the station public address/transit passenger information system (PA/TPIS), the supervisory control and data acquisition (SCADA)/hub monitoring and control system (HMCS), the Avaya telephone system, the Power SCADA system, fare collection (AFC2.0), and corporate IT systems.
- **The Security Wide Area Network (SWAN):** The communications medium for the closed-circuit television (CCTV) system, the electronic access control system (EACS), and the emergency call box system.
- **The GLX Signal System:** Uses the dedicated signal network to connect the new equipment located in the CIHs with the existing Green Line signal network. The OCC network and Green Line AVI systems are subscribers to the signal network.

New core (10GPS) and LAN (1GBPS) data switches will be provided at node locations to expand the WAN (Cisco) and SWAN (extreme) networks. MOXA data switches will be provided for the signal network expansion. IP address schemes and virtual private networks (VPN) will be developed in coordination with the MBTA current IP network plan to integrate these new switches, and their data traffic.

The three communications networks will use two new, diversely routed, 96-strand fiber optic cables extended from the GLX stations, CIHs, Transportation Building, and the Vehicle Maintenance Building (VMB) to the existing fiber optic termination locations at North Station, North Station Garden, and Science Park Station. Additional fiber optic cables will be installed to support ancillary locations, such as traction power substations (TPSS) and pump stations. All fiber optic patch panels and port assignments will be provided to the MBTA for inclusion into its communication department's fiber optic database.

To support data and telecommunications services within GLX locations, category 6 data cable will be provided from the closest communications distribution location to jack locations as shown on the project drawings. At locations where Ethernet limits are exceeded, communications cabinets will be installed. These cabinets will be connected to the core switches via fiber optic cable. The cabinets will house hardened data switches, patch panels, power supplies, and uninterruptible power supply (UPS) units. This wiring approach is currently deployed as an MBTA standard design developed to meet current requirements, while providing infrastructure to accommodate future needs.

Voice over Internet Protocol (VoIP) Telephone System

Currently, the MBTA has an Avaya telephone switch located at the OCC to provide telephone service to various locations throughout the MBTA via the WAN. This Project will provide an IP gateway at the VMF to provide telephone service (VoIP, digital, and analog) for the offices and support rooms at the VMB and the Transportation Building. An analog audio module will be provided so staff can make in-building public address announcements through their telephone. An ancillary component of the telephone system will be an audio logging recorder. This unit will be configured to record the telephones within the VMB and Transportation Building.

In addition to telephone service provided through the Avaya telephone switch, the Project will provide Verizon points-of-demarcation at the GLX stations, the Red Bridge TPSS, and the VMF. These new facilities will provide leased communications services to the GLX. Centrex telephone circuits will be deployed to the wayside telephones (up to three telephones per circuit). Wayside telephones will be located every 500 feet along the ROW and at interlockings, truck pads, and emergency egress gates. Each location will have surge protection terminals, be labeled with their location, and be equipped with a blue marker light.

Public Address and Transit Passenger Information System

Each new station's PA/TPIS will provide ADA-compliant audio and visual broadcasts. Each station system will be configured for mezzanine, eastbound, and westbound zones (additional zones will be provided as required). The PA/TPIS's major components include: two-line amber LED variable message signs (text size to be ADA compliant), loudspeakers, ambient noise sensing microphones (to automatically adjust audio levels per ambient noise levels), digital signal processor, power amplifiers, mixer, microphones, router, VoIP gateway, and station control unit (SCU). The SCU will be provided with Rockwell Collins' (formerly ARINC) Advanced Information Management (AIM) software that will interface, via the WAN, to the existing PA/TPIS headend at the OCC. The GLX station PA/TPIS will be added to the existing headend databases, and the graphical user interface screens for the OCC will be updated to include the new stations. The announcement schedules will also be updated to include the new stations. Updated announcements will be recorded to add the new stations to the PA headend.

In-building PA systems will be provided for the VMB and Transportation Building. These systems will be local to each building, and not interface to the OCC. Each system will consist of loudspeakers, digital signal processor, power amplifiers, mixer, and microphones. Users will access these systems via analog outputs from the new Avaya telephone system gateway.

Loudspeaker placement and tap settings, and amplifier configurations, will be optimized to provide uniform sound coverage throughout areas where passengers and employees will be located. Additionally, 90% of Speech Transmission Index measurements for the PA systems will exceed 0.45 within these areas.

Figure 4.1-8 Communication System Chart.

Communication System Design and System Functionality by Location

WBG team members worked directly with the design of each of these systems and integration to active systems, including developing acceptance test plans.

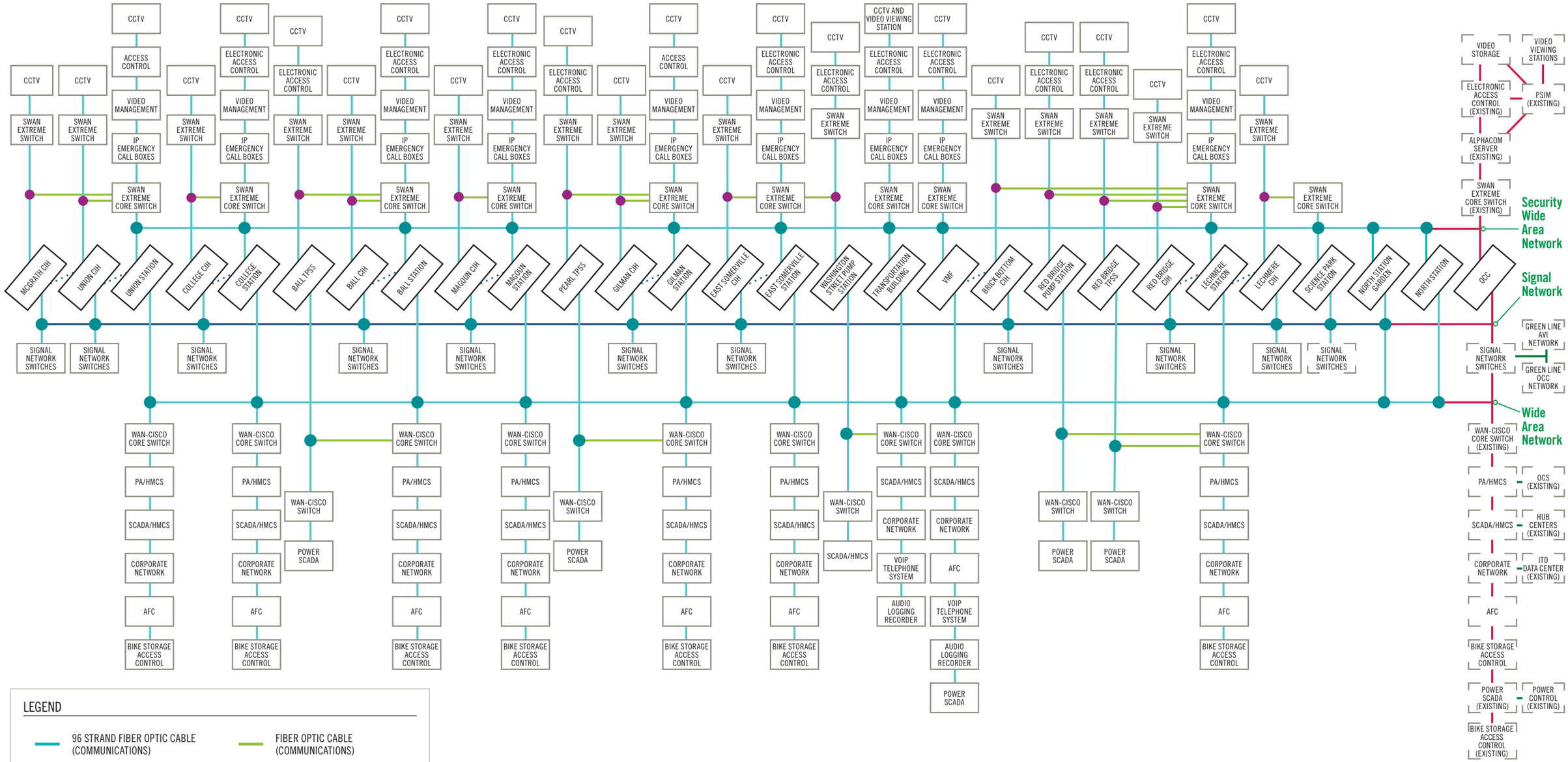
Interface each communication and security system to corresponding system.

Use Ethernet over fiber optic/copper cable for data transport.

Coordinate with respective system and MBTA for configuration files and IP addressing.

	Typical New GLX Station	VMF	Transportation Building	Traction Power Substations	Pump Stations	Central Instr. Houses
Fiber Optic Networks	●	●	●	●	●	●
Fiber Optic Networks (Signals)						●
VoIP Telephone System		●	●			
Public Address to 45 High Street	●					
Public Address Local		●	●			
Transit Passenger Information System	●					
Closed Circuit Television	●	●	●	●	●	●
SCADA with Hub Monitoring and Control System	●	●	●	●	●	
Access Control System	●	●	●	●	●	
Fare System Interface	●					
Uninterruptible Power Supply	●	●	●	●	●	●
Emergency Call Box	●	●	●			

Figure 4.1-9 Systems Topology Diagram.



LEGEND

- 96 STRAND FIBER OPTIC CABLE (COMMUNICATIONS)
- 96 STRAND FIBER OPTIC CABLE (SIGNALS)
- 96 STRAND FIBER OPTIC CABLE (SIGNAL-COMM)
- EXISTING EQUIPMENT
- FIBER OPTIC CABLE (COMMUNICATIONS)
- EXISTING CONNECTIONS
- 96 STRAND FIBER OPTIC CABLE TERMINATION LOCATION
- FIBER OPTIC CABLE TERMINATION LOCATION

NOTES

1. Networks are to be provisioned in ring configurations.
2. Communications fiber optic cable to be installed on the west side OCS catenary poles. Signal fiber optic cable to be installed in the trough. All fiber optic cables to be installed in 1.5" inner duct. Additional fiber optic cables to be installed from the communication rooms to: central instrument houses, pump stations, and TPSS. All fiber optic cables to be single mode.
3. Slack fiber optic cable to be located at each termination site.
4. Each network will utilize two optical strands from both the communications and signals fiber optic cables.
5. Optical fiber strands to be terminated and configured per Technical Provisions Section 11.7.
6. SWAN and WAN will be configured at 10 gb/s. Station and facility LANs will be configured at 1 gb/s.
7. IP addresses, VPNs, and port assignments to be coordinated with appropriate MBTA departments.
8. 5-year Cisco SmartNet contract to be provided for Cisco equipment.
9. AFC interface will be coordinated with the AFC2.0 project office.
10. The HMCS SCADA system will be used by the hub centers to monitor pumps stations, emergency generators, elevators, and fire alarm panels.
11. All communications network elements shall be supported by the UPS and station emergency power.

Closed Circuit Television

The CCTV system is used to provide remote surveillance and video recording of areas throughout the GLX project limits for the operations and security departments and transit police. All video cameras will be incorporated into the MBTA's physical security information management (PSIM) system. Live and recorded video can be viewed at a number of client workstations throughout the MBTA. A client workstation will be provided for the yardmaster's office at the Transportation Building. Single person train operator weatherproof monitors and video decoders with dedicated feeds of CCTV cameras viewing the platforms will be provided at the first car marker of each eastbound and westbound platform to assist the motorpersons in LRV door operations.

Power over Ethernet (PoE) IP-based cameras will be placed within stations at critical locations to view platforms, fare vending machines, walkways, bike storage areas, elevators, and secure rooms. Cameras are also proposed at the interlockings and ROW access pads. Exterior cameras will be located at the VMF, TPSSs, and pump stations.

To support single person train operations, we will provide video decoders and outdoor-rated monitors at the end of each platform. Each monitor will display four video streams from cameras mounted on the corresponding platform so the motorperson can verify that passengers are clear of the trolley before door closing.

The Project will provide video management and storage solutions for the proposed video cameras. Video servers will be added at the MBTA's data center at 45 High Street to store video.

Supervisory Control and Data Acquisition System with Hub Monitoring and Control Systems

Remote monitoring of pump stations, generators, fire alarm panels, and elevators will be accomplished through the HMCS. Input and output points for the various devices will be connected to new communications programmable logic controllers (CPLC) to be located at GLX stations, the VMF, and pump stations. The CPLCs will interface to the redundant HMCS servers at the OCC via the WAN. The servers will be updated with the new field CPLCs. New HMI menus and graphical user interface screens will be developed for use by the hub center operators.

The HMCS is separate from the Power SCADA system. The Power SCADA is dedicated to the remote monitoring and control of traction and unit power substations, and is used solely by the MBTA Power Department. Each Power SCADA system will connect to the MBTA data center at 45 High Street via the WAN. The power dispatcher graphical user interface screens will include the new substations.

Access Control System

The EACS is based on the existing MBTA Lenel On-Guard security platform and will provide access through secure portals to users with authorized credentials. Card readers, door contacts, and electric locks will be provided at doors that lead to critical infrastructure such as communications, electrical, and elevator machine rooms. Double card readers and stanchions will be provided at the entrance to each motorized lift gate. Each card reader will interface to a local access control panel that will then interface to the MBTA PSIM via the SWAN. The PSIM will be updated to include alarm rules such as door propped or forced open. Some portals require monitoring only (such as TPSS roll up doors), and will be equipped with just magnetic door contacts.

Separate from the EACS is the access control system for the bike storage areas. This Access Control System (ACS) will use the WAN to transmit ACS database information to the existing Honeywell Central Access Control Server located at 10 Park Plaza. The ACS will be configured to read iClass and MIFARE cards, and the system will be updated to include the new GLX locations.

Fare System Interface

The next generation of the MBTA fare collection system is in the early development stage to upgrade from the initial system installed a decade ago to AFC2.0. This project will coordinate with the AFC2.0 project as the design progresses. Although the stations will not include fare gate arrays, each station will be provided with fare vending machines. Data cabling will be installed to each fare vending machine location to provide WAN connectivity.

Uninterruptible Power Supply

All of the communications and security systems require back-up power. These requirements vary amongst the systems. Each communications and security system will have a rack, panel, or DIN rail-mounted UPS that will provide back-up power.

Emergency Call Boxes

The proposed Emergency Call Boxes (ECB) are IP-based, ADA compliant, and compatible with the existing Stentofon AlphaCom server located at the OCC. ECBs will be located per ADA regulations on platforms, walkways, at elevator landings, in elevator cabs, and at bike storage areas; and will be equipped with LED-based blue marker lights. These units will have two call buttons, one for emergency and one for information. Emergency calls will be routed directly to the MBTA Transit Police, while information calls will be routed to the hub centers. Non-emergency units (no emergency button) will be placed at the two motorized gates that lead into the VMF. The Project will coordinate call sequences with the MBTA.

Separate from the MBTA security system ECBs will be solar powered, wireless ECBs that meet City of Somerville specifications. These units will be located at 1,000-foot intervals along the Community Path.

Additional Equipment

In addition to all of the system requirements listed above, we will supply two-way portable radios for each piece of hi-rail equipment and various splintered work parties during work in, or adjacent to, a location that could affect Green Line operations. The Project will also provide three 800 MHz portable radios (and their maintenance) for the MBTA's exclusive use for the duration of the Project. These radios will be in accordance with the latest revision of MBTA Specification C6.

Open-Data Link Methods

The existing communications from the head end systems/servers at 45 High Street to the GLX field locations and edge devices will be transmitted via layer 2/3 Ethernet switching systems. As these are existing systems, each proposed individual GLX system device interface, protocol, and IP plan will need to be coordinated directly with the current application configuration files. This specific coordination will allow the respective head end applications to recognize the new field devices. Once the new devices are added to the system, they will be allowed to be controlled and monitored within the functionality of the individual application. Vehicle information and location will be trackable from the current OCC systems, and can be coordinated and continuous with the existing Green Line network of devices.

Proposed and Existing Communication Systems Interface

Each element of the GLX communications and security systems will need to be interfaced to their corresponding existing systems. The data transport of these systems will be via Ethernet over fiber optic/copper cable for each of the subsystems. Each interface will need to be specifically coordinated with each respective system to ensure seamless integration.

Early in the Project, WBG will meet with stakeholders to develop a Configuration Management Plan (CMP) to define roles and responsibilities, verify software versions and IP plans, and define configuration changes required and how they will be made. Without a comprehensive CMP, it is likely that required changes may be missed, incomplete, or unnecessary work performed because of lack of version and document control. The CMP will be a living document that evolves throughout the GLX project life cycle to provide current configuration status, change requests, version control, and hardware status on any of the affected systems, and coordinate work between codependent systems.

D. TRACK WORK SYSTEM DESIGN

Overall Approach and Technical Details

Construction of the proposed trackwork systems for the light rail and commuter rail within the limits of GLX will involve a systematic and integrated methodology where the requirements of the Project Technical Provisions are fully met. WBG understands the importance of providing the MBTA with an operationally efficient and expandable track system consistent with current MBTA best practices and industry standards.

Track Bed Structure Design

Conformance to the noise and vibration provisions will require that the team design and incorporate vibration isolation within the track bed structure to mitigate noise and vibration at highly-sensitive locations, including closely abutting residential dwellings and institutional facilities. At a minimum, such vibration isolation will include ballast mats and/or resilient rail fasteners to provide a cushion for the dynamic wheel loads imparted through the track structure, specifically via the train wheel/running rail interface, by the moving trains. In addition, specially-engineered trackwork

(such as flange-bearing, spring-rail, or moveable-point frogs) will be included where necessary to minimize the increase in noise and vibration from special trackwork (turnouts and crossovers).

Special Track Work Configurations

Typical special trackwork configurations and details are located at the end of Section 4.1. These conform to the RFP documents and to the subsections below.

Noise and Vibration Approach

To meet the Technical Provisions, WBG worked with Scott Edwards of DBE firm Cross-Spectrum Acoustics. Scott is familiar with the commitments outlined in the Project FONSI (Finding of No Significant Impact) and the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment guidance manual. In accordance with FTA criteria and procedures, a detailed noise assessment and detailed vibration analysis will be carried out to update the recommendations for noise barrier walls and vibration mitigation treatments from the preliminary design study. The analysis will serve to inform the design of noise and vibration mitigation treatments necessary to meet the Project requirements.

Rail Corrugation Approach

The GLX Project includes specific design elements to combat rail corrugation such as using head-hardened premium rail, restraining rail lubricators (Figure 4.1-10), and tight tolerances for the track gauge and horizontal alignment during construction and testing. Past studies indicate that common causes of rail corrugation include fastener stiffness, vehicle suspension, rail metallurgy, track geometry, and operating conditions. Regular maintenance of the track alignment, especially gauge and curvature, in combination with proper train wheel alignment and truing, has been shown to prolong the rail head life cycle and to limit excess noise associated with wheel/rail contact. Conversely, poor or limited wheel set (bogie) steering, as is common with the middle bogie of Green Line Type 8 LRVs, can contribute to irregular rail head wear. Proven measures to limit or prevent rail corrugation also depend on rail lubrication and regular monitoring/measurement of the rail heads using automated sensors mounted on push carts or hi-rail equipment. Early-stage rail corrugation left unchecked will manifest into a more pronounced and difficult corrugation pattern to mitigate. WBG will adhere to track construction tolerances, as defined in the RFP documents, to minimize the rail and track factors in the corrugation equation.

Proposed End of Track Device

WBG will install hydraulic bumping posts, shown in Figure 4.1-11, at all stub-end track sections in accordance with the Technical Provisions, Section 10.2 (l) (i) and to the dimensions shown on MBTA Maintenance of Way Division Book of Standard Trackwork Plans, Plan Number 925, Bumping Post for LRT Cars. The hydraulic bumpers are designed specifically for use with transit rail vehicles with a center of contact 25 inches above the top of rail and capable of stopping two fully loaded LRVs traveling at 6 mph. The hydraulic design will safely stop the train while minimizing train and coupler damage during accidental anti-climber contact. The bumping post will be installed using 1-inch heat-treated track bolts, bolted directly to the web of the 115 RE rail. There will be four connection points, with three bolts at each point for a total of 12 bolts. Insulated plug rail joints will be installed on both rails in front of the hydraulic bumping posts to isolate the track from signal system and negative power return currents.

Figure 4.1-10 Rail corrugation preventions. A solar-powered wayside rail lubrication system (left) helps to combat rail corrugation (right).

Figure 4.1-11 LRT hydraulic bumping posts located at stub-end tracks.

Special Track Work

Design Methods, Standards, and Criteria

See Figure 4.1-12 for special track work design methods, standards, and criteria that WBG will use to provide the special track work for the GLX Project.

Track Work Components

WBG is aware of the unique characteristics associated with the three LRVs that will operate on the GLX. The vehicle designs of the Kinki-Sharyo 7, Ansaldo Breda Type 8 and the proposed CAF Type 9 LRVs (Figure 4.1-13) each impose different requirements on the track structure and trackwork components. The Green Line trackwork infrastructure will be designed to accommodate the intricacies of these LRVs, with safety and ride quality at the forefront.

Figure 4.1-12 Special Track Work.

ITEM		THE WBG DESIGN METHOD	CRITERIA AND STANDARDS
Summary	**Special Track Work (Overall)**	» Manufactured from, and compatible with, 115RE rail section with 132# restraining rail section » Design and install on tangent track (horizontally and vertically) » Install on grades less than 2% » Fabricate and install in ballasted track on 7-in. by 9-in. treated wood ties using "Pandrol" type "e" clip and plate assemblies » Install all plates using .9375-in. screw spikes » Design, manufacture, and install bonded insulation joints (when applicable)	✔ American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering Volume 1 ✔ AREMA Portfolio of Trackwork Plans (current editions) ✔ MBTA MOW Division Book of Standard Trackwork Plans ✔ MBTA Green Line Light Rail Transit - Track Maintenance and Safety Standards ✔ MBTA Railroad Operations Book of Standard Plans ✔ Pertinent MBTA specifications
Special Trackwork Components	**Mainline Switch Points**	» Minimum of 30 feet of tangent track will precede switch points on mainline turnouts » Use Azobe tropical hardwood for timber switch ties	✔ AREMA Portfolio of Trackwork Plans Detail 5100 ✔ MBTA MOW Division Book of Standard Trackwork Plans - Plan No. 411 Standard Switch Point Detail 5100 and Heel Block Assembly
	VMF Switch Points	» 150-foot-radius turnouts	✔ MBTA Book of Standard Plans - Plan No. 615 Trackwork Plan for 150-Foot C.R. Turnout Fully Guarded Design LRT
	Mainline Turnouts	» Include guarded double switch point » Install with an asphalt underlayment » Power operated with exception of emergency crossovers located north of Cedar Street at approximately NB 320+00 and at crossover north of Lechmere Station at approximately MB 201+00 along the Medford Branch » Install emergency crossovers using an electrically locked T20 style hand throw switch and UBM or "jump" frogs	✔ Green Line Design-Build Project Contract Plans ✔ MBTA Railroad Operations Book of Standard Plans - Drawing No. 1030, Asphalt Underlayment
	VMF Turnouts	» Install with an asphalt underlayment » Use Racor 22 Switch Stands (or approved equal) for hand-thrown yard turnouts with back saver thrown arm and Aldron Company's low-profile switch cube direction indicator	✔ MBTA Railroad Operations Book of Standard Plans - Drawing No. 1030, Asphalt Underlayment
	Stock Rails	» Sampson undercut style » .125-inch tread depression point of switch to facilitate wheel flange transition to the turnout point » Graduated riser design » Stock rail brace plates at switch points machined to accept point heater elements	✔ MBTA Book of Standard Plans P- Plan No. 410 ✔ MBTA Specifications
	Frog Flangeways	» Design to accommodate LRV wheel profile and be flange bearing, solid manganese » Harden flange bearing surface to a minimum Brinell Hardness of 450HB » Where the crossover move is infrequent, use UBM frogs to mitigate noise, wear, and maintenance; provide a continuous wheel tread and flangeway; and safely transition the LRV wheel over the mainline by using a series of wheel tread and flange ramps	✔ AREMA Plan No. 671 ✔ MBTA MOW Division Book of Standard Trackwork Plans - Plan No. 850, Solid Manganese Frog Details

The track structure and components will be designed, manufactured and installed using higher than standard specifications for the allowable transit tolerances defined by the MBTA Maintenance of Way Green Line – Light Rail Transit Track Maintenance and Safety Standards. This higher standard will ensure the reliability of the components and their interface with the current and future LRV fleet. The Green Line wheel set and flanges are atypical, so diligence and attention to detail is paramount when designing and installing the track components and structure. The design of the trucks/wheelsets for the new Type 9 LRV will integrate improved braking capacity and thicker wheels to reduce maintenance and increase reliability.

Specifically-designed trackwork components will be incorporated into the rail system for the MBTA Green Line LRV, such as manganese cover guards at all turnouts, flange bearing and unbroken mainline frogs, adjustable restraining rail section using the Pandrol Adjustable Restraining Rail Plate or approved equal, LRV bumping posts, sliding block derails, guarded double switch points, and hook flange frog guards with specified guard-check-gauge tolerances.

Per MBTA standards, all LRT curves under a 1,000-foot-radius will be restrained using 132# restraining rail adjacent to the 115RE running rail. In these situations, WBG will join all restraining rail to the running rail using spacer block assemblies every 23 inches on center, in accordance with MBTA standards. The team has designed the alignment to minimize curves with a radius less than 1,000 feet, thus reducing the need for restraining rail, a known source of rail-borne noise and vibration. However, when the track geometry dictates that a curve must be restrained, we will install wayside back-of-wheel lubricators. These wayside lubricators will be Lincoln type, or approved equal, solar powered, fully programmable units with an electronic wheel sensor and multi-port delivery system. The wayside lubricators will be positioned to lubricate the contact surface of the restraining rail prior to the train entering the curve in the normal direction of traffic. The lubricators will be sized and adjusted in the field to maximize the effective distance of the lubricant.

Special Track Work Design

All Green Line special trackwork will be fully guarded through the turnout move with adjustable manganese cover guards to protect the switch point from wear and to minimize the potential for wheel climb derailments in the turnout move often associated with LRVs on sharper radius turnouts. A cover guard will be installed to accommodate the LRV wheel profile and back-to-back wheel tolerances. No portion of the cover guard or its assembly will be more than 2 inches above the top of rail. The flangeways through the turnout will be 1.625 inches with 56.5-inch gage, unless otherwise required by MBTA Standards. A 132# guard rail will precede the cover guard for a smooth transition in and out of the switch point area.

Restraining rail block assemblies will be installed in accordance with the approved drawings to provide full guarding from the toe of frog into the tangent track beyond. Special trackwork will have a minimum of 30 feet of tangent track preceding the switch point, allowing ample distance for the LRV to properly align prior to entering the switch on mainline turnouts. Similarly, and where feasible, a short section of tangent will be designed ahead of the switch points within the VMF yard. Restraining rail assemblies will be used to control and align the LRVs along the track where switches abut each other or are placed back to back, as is the case at the yard's ladder track.

Special Track Work Drawings

The following special track work drawings can be found at the end of Section 4.1:

- Special track work geometry, guardrails, and restraining rails
- All proposed track structure/rail fastening systems and their associated assemblies
- Signals and communications infrastructure

E. TRACTION POWER SYSTEM DESIGN

The traction power scope of work for the GLX Project includes a new traction power system (TPS) for the extension. The traction power will be supplied by TPSSs located along the corridor and shall supply the main line tracks and the VMF.

Traction Power Supply Design Process

The design process for the traction power system will build upon existing MBTA design documents, load flow study, and standards. The traction power design will concentrate on providing a reliable system that is safe and easy to maintain. Furthermore, we understand GLX is not a new start and must seamlessly integrate with an existing passenger rail line. WBG will produce a design that can be constructed with minimal disruption to existing service.

Developing the system requirements is an integral part of the traction power system design. The traction power design team greatly benefits from the previous design efforts. The directive drawings, RIDS, MBTA standards, and load flow study will form the basis of our design and allow us to quickly develop a solid traction power design package. All of these elements will be scrutinized and applied to develop the traction power system.

The traction power load flow simulation will be performed using a software tool that has been nationally validated on many other passenger railroad projects. WBG will use either Train Operations Model (TOM) or Mott McDonald's TRAIN package. The results will be validated by manual calculation and provided in report format with the accompanying input data. This step is a crucial independent check against modeling errors.

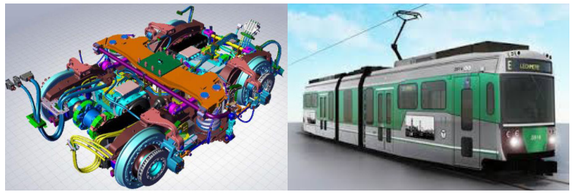
Additional system simulations and studies will include short circuit and relay coordination studies using internationally recognized software packages, such as SKM products. Each set of results will be checked against manual calculations as with the load flow.

The traction power design schedule has been organized for early completion of design elements with long lead times to allow adequate time for procurement and testing.

The traction power system for GLX consists of three new TPSSs. The first TPSS is Red Bridge, which provides power to the Medford and Union Square Branches, as well as the VMF. The Red Bridge TPSS provides a DC feeder to the VMB where a local distribution set of switchgear will be utilized to provide stinger power for maintenance. The second TPSS is Pearl Street, which provides traction power to the Medford Branch as well as loop AC feeders along the ROW to the third TPSS, Ball Square. Ball Square TPSS provides power to the Medford Branch.

The TPSSs receive power from third party utility services (Red Bridge and Pearl Street) and from loop feeders (Ball Square) from the adjacent Pearl Street TPSS. The TPSS design will meet the utility requirements for service. The utility services are recognized

Figure 4.1-13 Proposed type 9 LRV rendering (left) and wheelset isometric view (right).



as key risk items, therefore special early effort will be applied to these items to ensure they are available when necessary. Traction power from the TPSSs will be distributed for use via a distribution network consisting of the OCS and parallel positive and negative feeders that are bonded together at appropriate intervals.

The TPS is intended to work as an integrated system. Nominal conditions for the TPS allow each substation to provide DC power for the trains to use. Under first contingency operations, where one rectifier at a single substation is out of service, the substation may be configured to allow normal operations. A second contingency situation, where an entire substation has failed, is accommodated by operating the wayside switches at the failed substation to "eliminate" the substation from the TPS and allow the adjacent TPSS to provide power to accommodate the load in the section served by the failed TPSS. The train service would not be degraded under these conditions. WBG intends to provide a TPS that is robust enough to sustain a second contingency failure with no degradation of service, per industry standards.

Additionally, the headways, authorized speeds, and travel times included in the basis of design documents, particularly the requirement for 25% greater headways (more frequent service) to assist in service recovery after a disruption, will be incorporated in the project design requirements, and the TPS will be able to support these requirements. TPS behavior will be tested under nominal and contingency modes of operation in the traction power simulation. WBG and Comstock/Fischbach & Moore JV will confirm with MBTA to make certain the TPS operation is understood and acceptable.

The traction power substations provide DC power for the rail traction and three-phase AC power for the passenger stations. These feeders will run along the ROW and provide one of the two redundant power feeders for each station.

The traction power design will, to the extent possible, use the pre-purchased materials indicated in the RFP.

Traction Power Supply Design, Failure Modes, and Mitigations

The traction power distribution system is designed to be robust and reliable under normal and contingency (failure) modes of operation. The basis of the design will be the operating plan, and the system performance will be software validated including post-construction power flow measurement. The previous load flow simulation report has been reviewed and its results will be considered, compared with the study WBG will perform, and incorporated in the design as relevant. The power system design will allow normal operation with any one TPSS out of operation. The power system will allow the distribution system to be sectionalized to "cut out" the faulted TPSS at both the line side disconnect switches or the TPSS DC bus depending upon the failure mode. If a fault in the DC substation equipment is the cause, the line side switches are the logical sectionalizing location. If the fault is the AC section of the TPSS, then the DC bus may be used to "feed through" the traction power. The OCS will be designed to be fault tolerant and allow sections of the OCS to be taken out of service and traffic maintained within the limitations of the track switches.

Each TPSS will include all conversion equipment, control, relaying, controls, and associated components to operate the Project. They will include DC positive feeder cables, negative return cables, supplementary positive and negative cables, and DC disconnect switches as required to provide power to the OCS. The system will be capable of operating AW3-loaded project and existing system vehicles at five minute headways under normal and single contingency outage scenarios without any detriment to operating service.

The DC power system will be separated into electrical sections with section breaks near each TPSS. OCS feeder switches and TPSS bypass switches will be provided to enable a substation to be removed from service while allowing two electrical sections to be joined together. Provisions for an OCS tie switch will be provided at each end-of-line location (Union Square and Ball Square) to connect the OCS of each track together.

The traction power return system will include the running rails and supplemental return cables. The traction power return system will interface the impedance bonds at the track with the negative return busbar within each TPSS. Each track will be provided with 2-2,000 KCMIL returns per track to the TPSS negative busbar. Midway between substations, the running rails of each track will be interconnected via impedance bonds to share the rail return current equally. The tracks at the end of the line will be connected together via impedance bonds. A single 2,000 KCMIL supplemental negative cable will be provided throughout the project corridor. This cable will be shared between the two tracks and interconnected at each TPSS return connection and at each mid-point between substations. The supplemental return cable will be installed directly on the ballast between the tracks.

A full and complete traction power system commissioning plan will be developed. The commissioning plan will feature product qualification testing, manufacturers testing, and field testing for each element of the traction power system, as well as for the traction power system as a whole.

Conceptual Traction Power System Single-Line Diagram

This diagram is provided at the end of Section 4.1.

F. OVERHEAD CONTACT SYSTEM DESIGN

The OCS will be designed to be compatible with the MBTA LRV electrical and dynamic performance requirements to ensure that the vehicle pantograph maintains contact with the contact wire under local climatic, environmental, and operating conditions. The OCS consists of a two-wire auto tension system on the Medford Branch and Union Square Branch, and a single variable tension contact wire in the VMF with double insulation.

Pantograph security will be established by maintaining a minimum contact wire edge distance from the horn of the pantograph under the worst operating condition. A pantograph security analysis will be performed in accordance with UIC 606-1. A safe zone of 6 inches will be used from the centerline of the pantograph for stager and offset. Based on the analysis, a structure spacing chart will be developed to maximize the pole spacing and minimize the overall structure count.

GLX typical OCS arrangements.

Typical portal with independent messenger and contact.

Proper clearance between OCS and underside of low bridges.

Typical side pole arrangement with AC and DC feeders on separate arms.

The OCS components in tension used for the messenger and contact wires and down guys will be forged, formed, machined, or drawn to prevent any casting defects. The OCS will be supported from cantilever pipes or spans wires (with pulley) insulated from the supporting structure with double insulation. The messenger wires will be supported under the top pipe to prevent binding as the cantilever swings along the track due to temperature changes.

The OCS will be electrically supplemented with parallel feeder cables, in underground conduits or aerial on poles as required by the traction power system design. Feeder taps to the OCS will be located per the load flow analysis.

Typical OCS Arrangements

The at-grade section along the alignment will use side poles and portal structures. WBG proposes using independent messenger and contact registration to register the contact wire. This will minimize the effect of an OCS wire tear down on adjacent wires. The areas along the ROW with height constraints (existing overhead bridges) will be handled individually to ensure proper electrical clearances between the OCS and the underside of the bridge. The DC and AC feeders will be lowered to pass under bridges. The electrical clearances will follow NESC and MBTA requirements.

OCS Sectionalization

The OCS will be sectionalized to maximize train operations and flexibility in regard to maintenance and emergency operations. Sectionalizing will be provided at interlockings and substations to provide train movement along the alignment during diverted train operations (non-normal operations).

Typical OCS Pole Arrangements

WBG will use portal structures at the interface point between the existing Lechmere viaduct and the new Lechmere viaduct at existing Pier 13 at Charlestown Avenue. The portal structures will transition to side poles and remain side poles for the remaining lengths of the two track Lechmere and Medford Branch viaducts. The Union Square eastbound and westbound viaducts support single tracks and will use side poles positioned on the outside of curves. Where noise walls are required, the OCS poles will be integral to their construction. The new poles will accommodate the AC and DC aerial feeders on separate arms and be vertically spaced to provide required electrical clearances. The OCS supports for each track will be single track support brackets where possible, as this will minimize the effect of a wire tear down on the adjacent track. This approach allows the adjacent track to be operational during an emergency.

G. AC VOLTAGE DISTRIBUTION

Typical AC Voltage Services

Utility services for the traction power substations will be medium voltage services and make use of the services previously negotiated with Eversource. All service equipment will meet Eversource requirements.

Medium voltage feeders for passenger station backup power will be provided from the TPSS medium voltage switchgear and be routed along the ROW, either on OCS poles or in ductbanks along the viaducts. Medium voltage ring feeders will be provided between Pearl Street TPSS and Ball Square TPSS. These will be routed in

a similar fashion to the passenger station feeders. The medium voltage system will be controlled and monitored locally and via SCADA as described in Section 16311.

Redundant Supply

A TPSS will provide one of the two redundant electric feeds for each station and the other electric feed will be provided from another independent utility feed. A UPS system will be provided in each station and building to provide back-up power to life safety loads, as defined in Section 14.5.3.5 of the Technical Provisions. A standby gas generator will be provided at the VMB and Lechmere Station to provide back-up power to all emergency and optional standby loads.

H. CORROSION CONTROL

GLX installation presents several corrosion control concerns, including stray current corrosion on the system components and foreign structures, soil and water corrosion on underground or submerged utilities, and atmospheric corrosion of system structures. These concerns will be addressed as described in this section.

Corrosion Control Strategy

CorrPro is a leader in the cathodic protection field providing corrosion engineering services across multiple industries, including transit. They have a nationwide transit footprint providing design and testing services for the protection of track, utilities and structures from the corrosive effects of the stray currents generated by an operating DC-powered transit system. Key systems and track subcontractors Comstock and RailWorks have had success working with CorrPro on multiple transit projects. The installation of the GLX Project presents several corrosion control concerns. The major areas of concern and mitigation are shown in Figure 4.1-14.

Corrosion Control Methodology and Design

Piping systems installed along the system route will be supplied with cathodic protection systems to reduce stray current corrosion and soil or water corrosion. The piping cathodic protection systems will include electrical continuity of the piping included in the system, and electrical isolation of the piping from foreign structures. The piping will be supplied with protective coating and sacrificial anodes to provide protection current. Test stations will be provided on the piping systems for the evaluation of cathodic protection levels, as well as stray current effects. We will address atmospheric corrosion of system components through the use of properly selected materials and coatings or sealants, as required.

Figure 4.1-14 Corrosion risks and mitigation strategies.

RISK	MITIGATION
Stray current corrosion of transit system components	Electrical isolation of track and negative return system components to reduce or eliminate stray currents
Stray current corrosion from foreign structures	Cathodic protection of underground piping systems as well as stray current drainage facilities for utilities, support structures and services
Soil and water corrosion on underground or submerged structures	Cathodic protection for piping systems
Atmospheric corrosion of system components	Properly selected materials and coatings and sealants

Track to earth resistance levels are generally high when the system is first installed, therefore stray current levels will be low. Track to earth resistance testing performed on short sections of track while they are being installed will assure that the electrical isolation of the track is maintained to its highest achievable levels. Over time, the insulating components of the tracks will degrade, and moisture and debris will accumulate around the rails. This will lead to reduced track-to-earth resistances and increased stray currents. Therefore, all utilities and system structures, such as retaining walls and reinforcing steel in concrete, will be installed with stray current mitigation controls.

Stray currents from the tracks tend to find alternate paths back to the traction power substations. The stray current flows along foreign metallic structures and then discharges to the ground when it encounters electrical discontinuities or flows back to the rails to return to the substation. Corrosion will occur where the current discharges from the metallic surface to the ground. To prevent corrosion on metallic structures, they will be installed with measures to ensure electrical continuity. These measures will include bond wires across pipe joints, welding reinforcing steel in concrete, and continuity bond wires or bars along sheet pile or soldier piles. These electrically continuous structures will then be supplied with stray current drainage facilities to allow the stray current to flow back to the negative return system without detrimental effects, should the need arise. Test stations will be installed along the structures for the evaluation of stray current effects.

Reducing Stray Current

The operation of a DC-powered transit system will produce stray currents. The goals of WBG's corrosion design include keeping the magnitude of stray currents to minimal levels and mitigating their effects on the metallic structures located along the GLX route. The potential sensitive receptors of this stray current include utilities, bridge structures, and other metallic infrastructure, as well as the new transit system components including track, structural supports, and retaining walls. Traction power substations will be spaced to keep track-to-earth voltages at acceptable levels. High track-to-earth resistance values will be achieved in ballasted track by separating any portion of the rail from the ballast by a minimum of one inch and providing proper track bed drainage. If the track-to-earth voltages are kept to minimal levels and the track-to-earth resistances are kept to the highest achievable levels, then stray currents should be minimized.

After the transit system is installed, but before it is operational, WBG will conduct a stray current survey to measure stray current levels along the system route. This survey will involve monitoring structure-to-ground potentials on system components, as well as foreign structures. Monitoring will be performed for short terms (15 to 20 minutes) if no stray currents are detected, and for longer term (24 hours) if effects are noted. After the system is operational, the stray current survey will be repeated with testing performed at the locations tested prior to operation, at a minimum. A comparison of the test results will indicate if the new system is producing stray current effects. If stray currents effects are detected, then WBG will determine if additional actions, such as activating stray current bonds, are necessary.

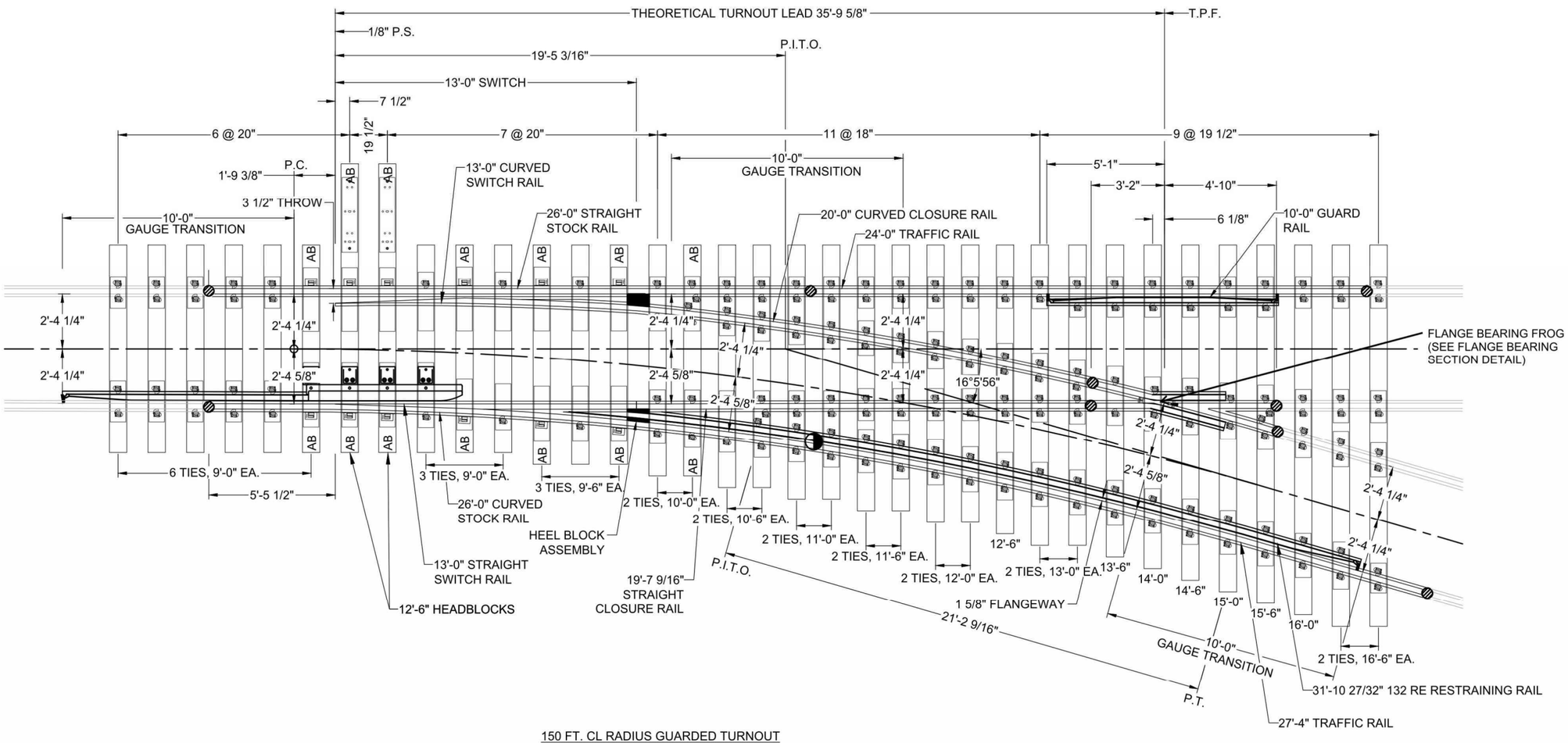
Monitoring and Metering Stray Current During Construction

During construction, the track-to-earth resistance will be tested on short sections of track (approximately 1,000 feet) to ensure that the track resistance is kept to the highest attainable levels. This will keep stray currents to a minimum. Stray current survey will determine if stray current effects are present on existing or newly installed structures. This will be done by monitoring structure-to-earth potentials to determine if stray current effects are present. These effects will be compared to measurements repeated after the system is operational to determine the impact of the new transit system.

Stray Current Best Practices

The stray current best practices CorrPro has used on numerous other transit systems, such as Niagara Frontier Transportation Authority, Long Island Railroad, Baltimore MTA, WMATA, DART, and MBTA, include the measures described above. Effective track isolation to minimize stray currents, cathodic protection, and stray current drainage facilities for piping systems, support structures, and system services, are the most effective methods to minimize and mitigate stray current effects. Stray current surveys conducted on existing and newly installed utilities and structures will also indicate the magnitude of existing stray current effects and any stray current effects generated by the newly installed system. Additional mitigation actions, such as activating stray current drains, will be performed based on the results of the stray current surveys.

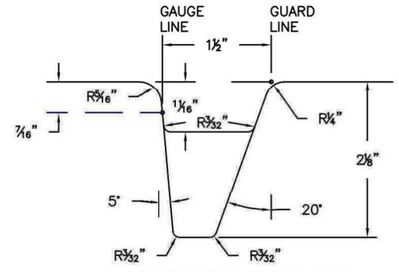
Figure 4.1-15 Typical 1-inch ballast-to-rail separation WBG will use to reduce stray current on the GLX Project.



150 FT. CL RADIUS GUARDED TURNOUT

5 0 5

1" = 5' - 0"
SCALE IN FEET



FLANGE BEARING SECTION DETAIL
NO SCALE

LEGEND

- INDICATES RAILS FURNISHED BY THE MANUFACTURER
- INDICATES RAIL FURNISHED BY THE INSTALLER
- INDICATES INSULATED JOINTS WITH 3/16" OPENING
- INDICATES JOINTS TO BE FIELD WELDED
- INDICATES JOINTS TO BE BOLTED
- AB INDICATES RAIL BRACE LOCATIONS
- INDICATES SPECIAL RUNNING RAIL AND RESTRAINING RAIL JOINT

NOTES:

1. GAUGE TRANSITIONS SHALL BE MADE ON INSIDE RAIL OF CURVE AND CONTINUE ON THROUGH SIDE ON INSIDE RAIL OF CURVE, IN TEN FOOT LENGTHS AS SHOWN.
2. MANUFACTURER SHALL SUPPLY FLANGE BEARING FROGS.
3. PROVIDE HMA UNDERLAYMENT IN ACCORDANCE WITH MBTA RAILROAD OPERATIONS STANDARD DWG NO. 1030.
4. ALL SPECIAL TRACKWORK WITHIN THE YARD IS TO BE BOLTED.
5. RAIL BRACES (AB) SHALL BE MACHINED FOR SWITCH HEATER ELEMENT INSTALLATION.

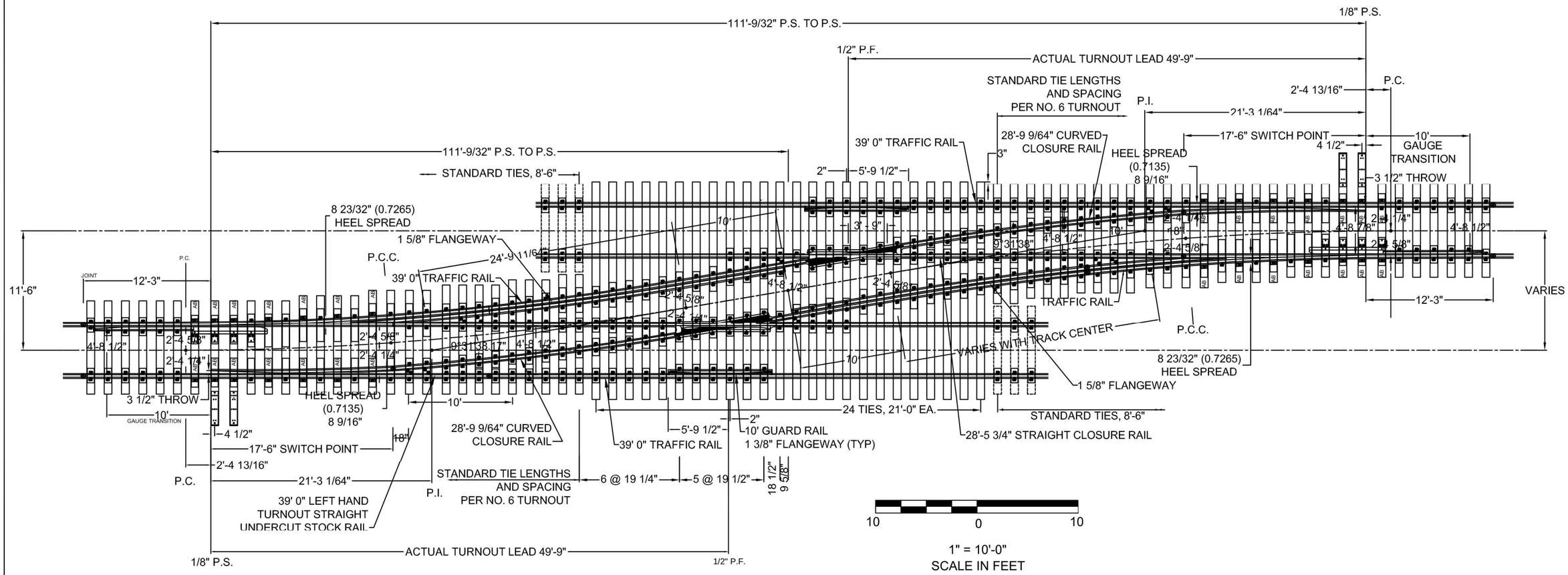
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

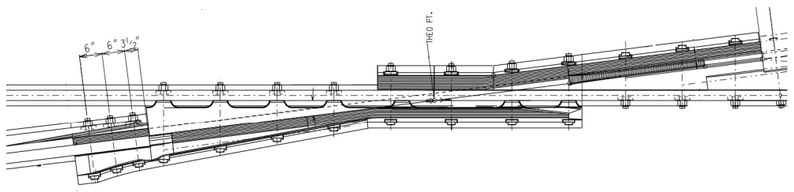
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

FULLY GUARDED 150' RADIUS TURNOUT WITH FLANGE BEARING FROG

DATE: SEPT. 28, 2017 | SCALE: **AS NOTED** | SHEET **000-K-0101**





BOLTED JUMP FROG
NO SCALE

LEGEND

- INDICATES RAILS FURNISHED BY THE MANUFACTURER
- INDICATES RAIL FURNISHED BY THE INSTALLER
- INDICATES INSULATED JOINTS WITH 3/16" OPENING
- INDICATES JOINTS TO BE FIELD WELDED
- INDICATES JOINTS TO BE BOLTED
- AB INDICATES RAIL BRACE LOCATIONS
- INDICATES SPECIAL RUNNING RAIL AND RESTRAINING RAIL JOINT

NOTES:

1. GAUGE TRANSITIONS SHALL BE MADE ON INSIDE RAIL OF CURVE AND CONTINUE ON THROUGH SIDE ON INSIDE RAIL OF CURVE, IN TEN FOOT LENGTHS AS SHOWN.
2. MANUFACTURER SHALL SUPPLY JUMP FROGS.
3. JUMP (UNBROKEN MAINLINE) FROGS SHALL BE DESIGNED TO TRANSITION THE TREAD/FLANGE/TREAD MBTA LRV WHEEL PROFILE OVER THE UNBROKEN STRAIGHT FROG RAIL.
4. PROVIDE HMA UNDERLAYMENT IN ACCORDANCE WITH MBTA RAILROAD OPERATIONS STANDARD DWG NO. 1030.
5. ALL SPECIAL TRACKWORK JOINTS SHALL BE WELDED WITH THE EXCEPTION OF INSULATION JOINTS.
6. INSULATION JOINTS SHALL BE BE LOCATED AS REQUIRED BY SIGNALS SPECIFICATIONS.

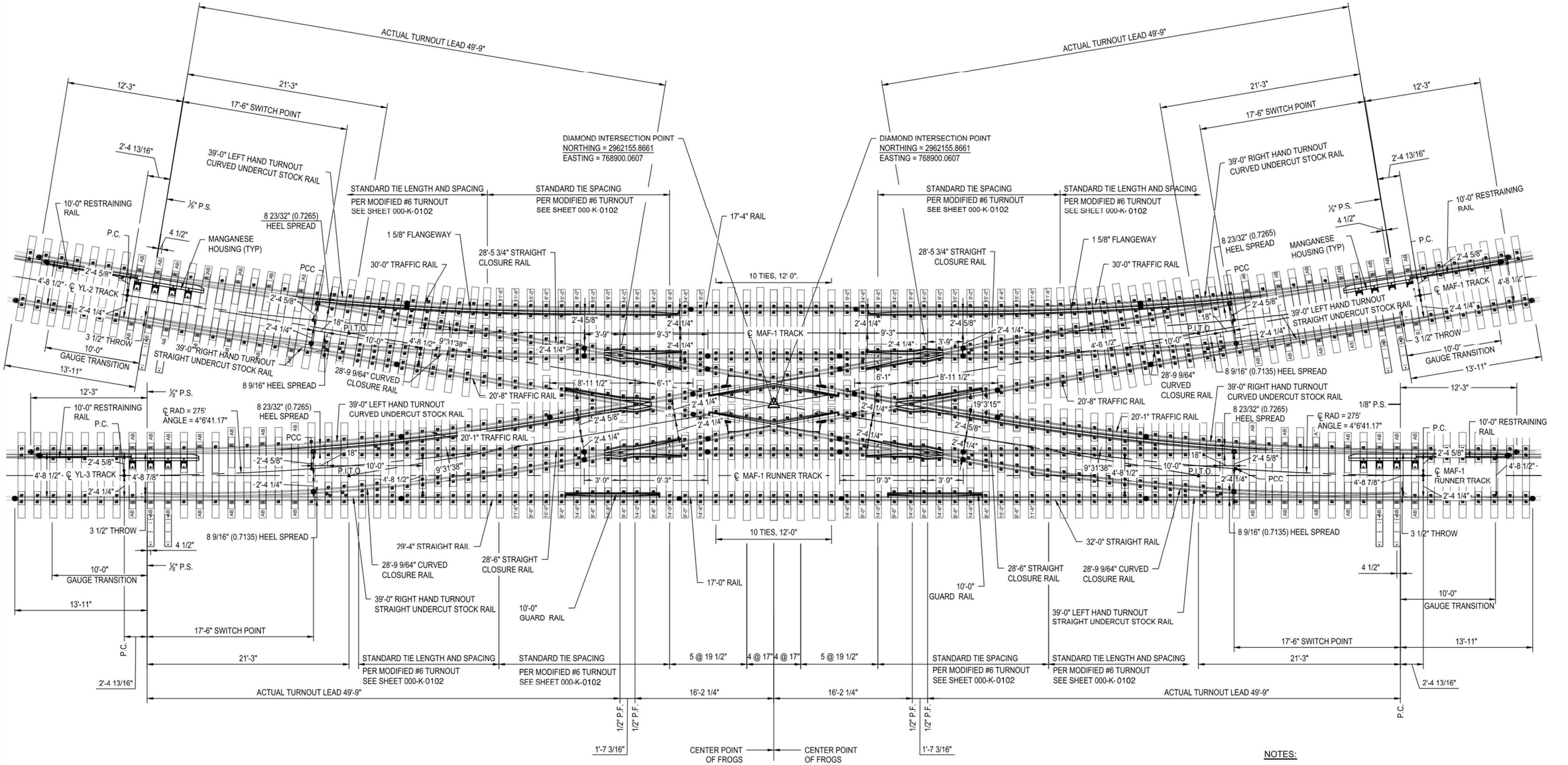
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MODIFIED NO. 6 - FULLY GUARDED CROSSOVER WITH LRV JUMP FROGS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-0102



LEGEND

- AB — INDICATES RAIL BRACE LOCATIONS
- INDICATES RAILS FURNISHED BY THE MANUFACTURER
- INDICATES RAIL FURNISHED BY THE INSTALLER
- INDICATES RESTRAINING RAIL FURNISHED BY THE MANUFACTURER
- INDICATES RESTRAINING RAIL FURNISHED BY THE INSTALLER
- INDICATES INSULATED JOINTS WITH 3/16" OPENING
- INDICATES JOINTS TO BE FIELD WELDED
- INDICATES JOINTS TO BE BOLTED

NOTES:

1. PROVIDE HMA UNDERLAYMENT IN ACCORDANCE WITH MBTA RAILROAD OPERATIONS STANDARD DWG NO. 1030
2. MANUFACTURER SHALL SUPPLY FLANGE BEARING FROGS.
3. GAUGE TRANSITION SHALL BE MADE ON INSIDE RAIL OF CURVE AND ON THROUGH SIDE ON STRAIGHT CLOSURE RAIL.
4. GUARD RAIL GAPS ARE REQUIRED AT SPECIAL TRACKWORK. SEE TRACK DETAIL SHEETS FOR FURTHER INFORMATION.
5. CROSSOVER SHALL BE FULLY GUARDED.

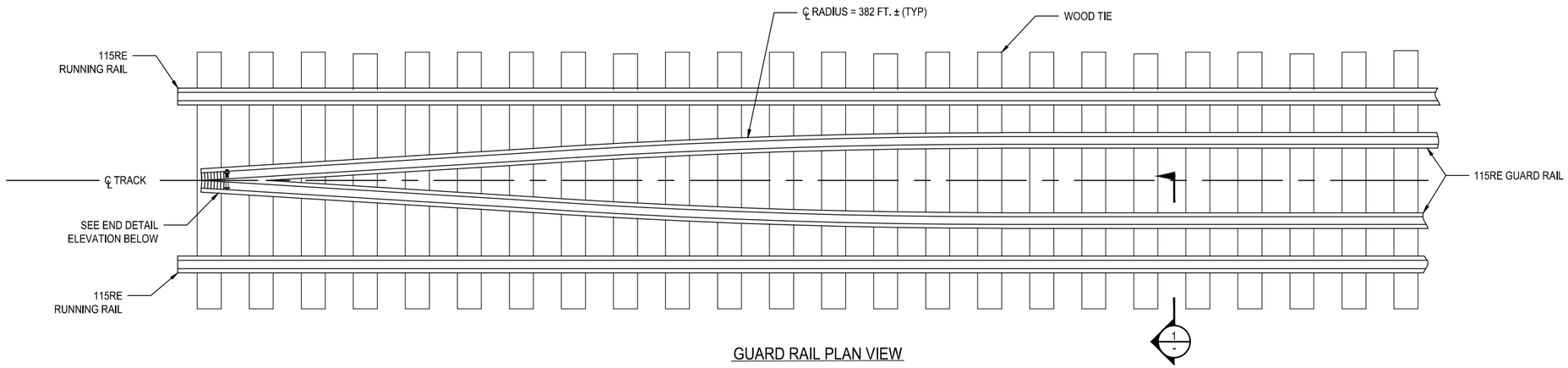
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

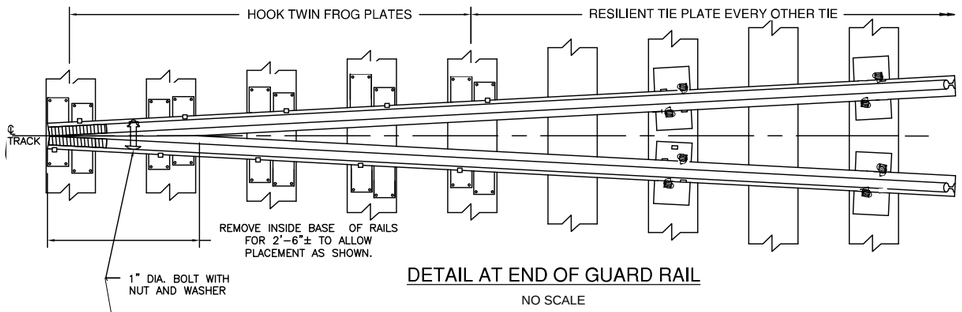
MODIFIED NO. 6 - FULLY GUARDED SPECIAL DIAMOND CROSSOVER

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-0103



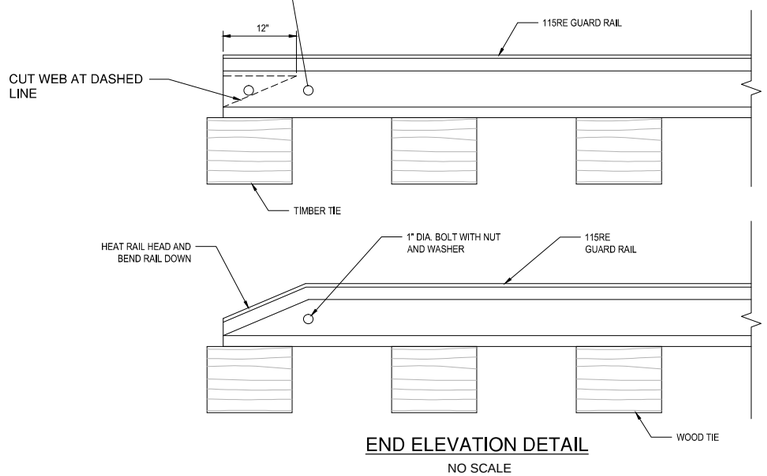
GUARD RAIL PLAN VIEW

NO SCALE


HOOK TWIN FROG PLATES
RESILIENT TIE PLATE EVERY OTHER TIE
℄ TRACK
REMOVE INSIDE BASE OF RAILS FOR 2'-6"± TO ALLOW PLACEMENT AS SHOWN.
1" DIA. BOLT WITH NUT AND WASHER

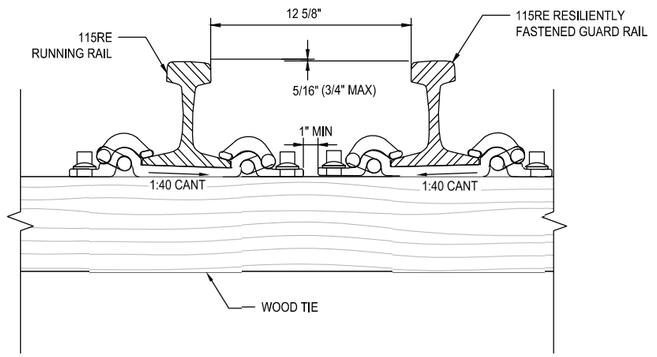
DETAIL AT END OF GUARD RAIL

NO SCALE



END ELEVATION DETAIL

NO SCALE



1 - SECTION

NO SCALE

NOTES:

1. REFER TO MBTA STANDARD DWG NO.'S 900 AND 905 FOR FURTHER DETAILS.
2. GUARD RAIL SHALL BE RESILIENTLY FASTENED TO EVERY SECOND TIE.
3. IN LOCATIONS WHERE GUARD RAIL AND RESTRAINING RAIL ARE BOTH REQUIRED, GUARDRAIL SHALL BE INSTALLED ADJACENT TO UNRESTRAINED RAIL ONLY.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE

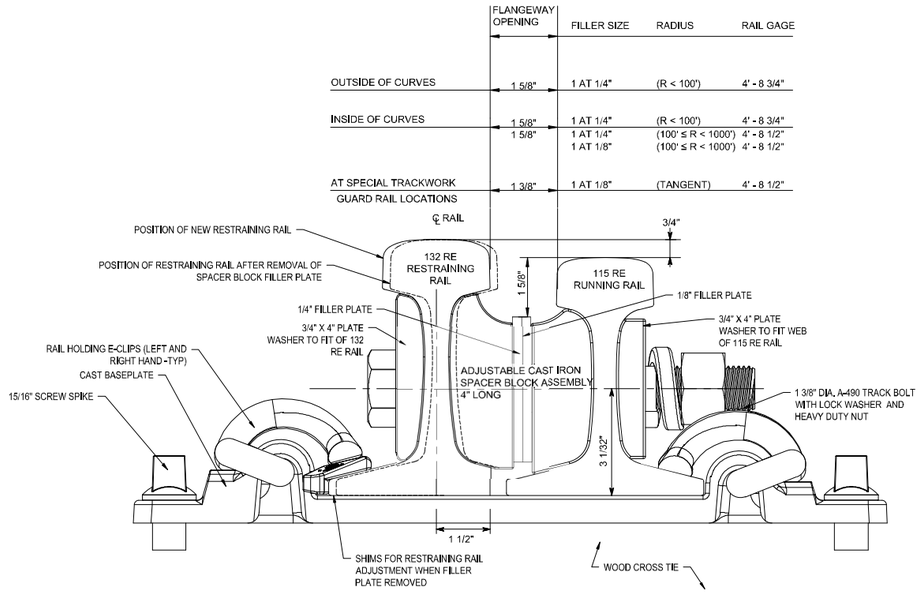
THE WALSH BARLETTA GRANITE

Joint Venture Team

EMERGENCY GUARD RAIL DETAILS

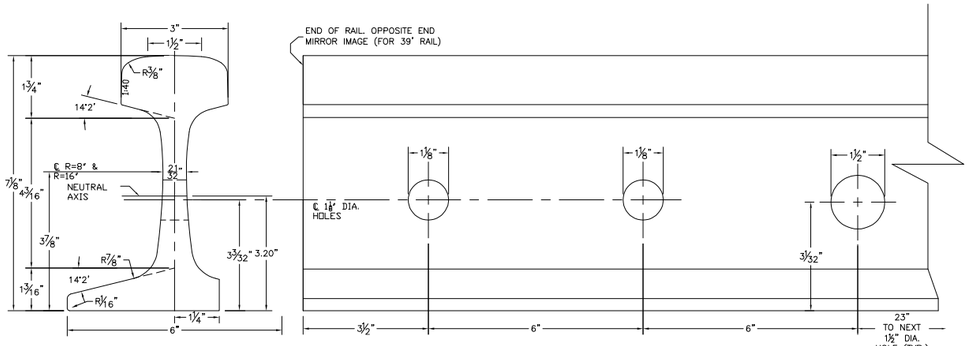
DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET 000-K-0104

	FLANGEWAY OPENING	FILLER SIZE	RADIUS	RAIL GAGE
OUTSIDE OF CURVES	1 5/8"	1 AT 1/4"	(R < 100')	4' - 8 3/4"
INSIDE OF CURVES	1 5/8"	1 AT 1/4"	(R < 100')	4' - 8 3/4"
	1 5/8"	1 AT 1/4"	(100' ≤ R < 1000')	4' - 8 1/2"
		1 AT 1/8"	(100' ≤ R < 1000')	4' - 8 1/2"
AT SPECIAL TRACKWORK GUARD RAIL LOCATIONS	1 3/8"	1 AT 1/8"	(TANGENT)	4' - 8 1/2"


℄ RAIL
3/4"
POSITION OF NEW RESTRAINING RAIL
POSITION OF RESTRAINING RAIL AFTER REMOVAL OF SPACER BLOCK FILLER PLATE
132 RE RESTRAINING RAIL
115 RE RUNNING RAIL
1.5/8"
1/8" FILLER PLATE
1/4" FILLER PLATE
3/4" X 4" PLATE WASHER TO FIT OF 132 RE RAIL
3/4" X 4" PLATE WASHER TO FIT WEB OF 115 RE RAIL
RAIL HOLDING E-CLIPS (LEFT AND RIGHT HAND -TYP)
CAST BASEPLATE
15/16" SCREW SPIKE
ADJUSTABLE CAST IRON SPACER BLOCK ASSEMBLY 4" LONG
1 3/8" DIA, A-490 TRACK BOLT WITH LOCK WASHER AND HEAVY DUTY NUT
3 1/32"
1 1/2"
SHIMS FOR RESTRAINING RAIL ADJUSTMENT WHEN FILLER PLATE REMOVED
WOOD CROSS TIE

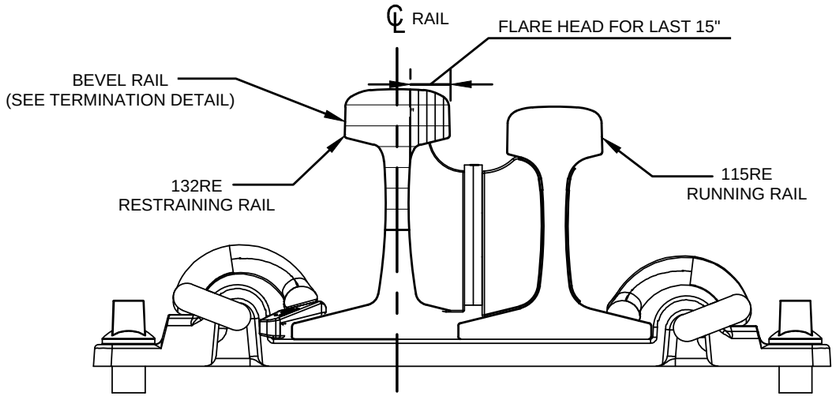
1 / - SECTION

NO SCALE



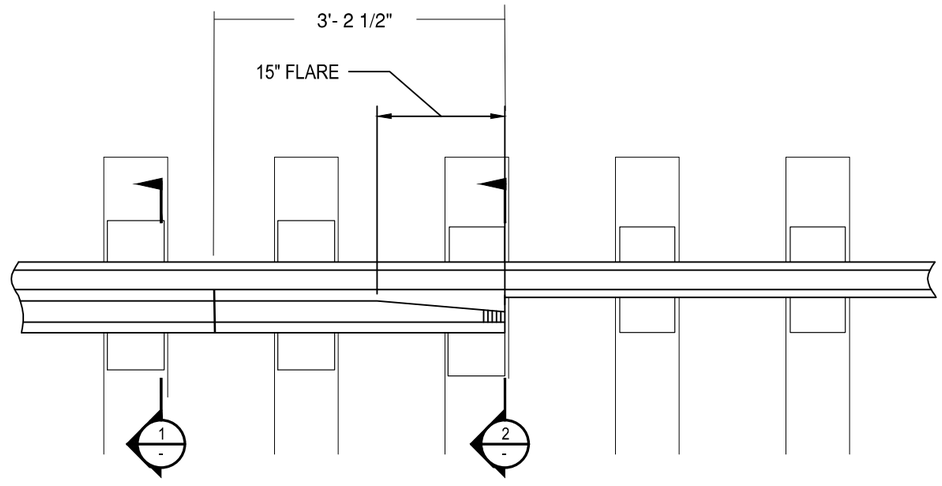
SECTION

DRILLING



2 / - SECTION

NO SCALE



RESTRAINING RAIL TERMINATION DETAIL

NO SCALE

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

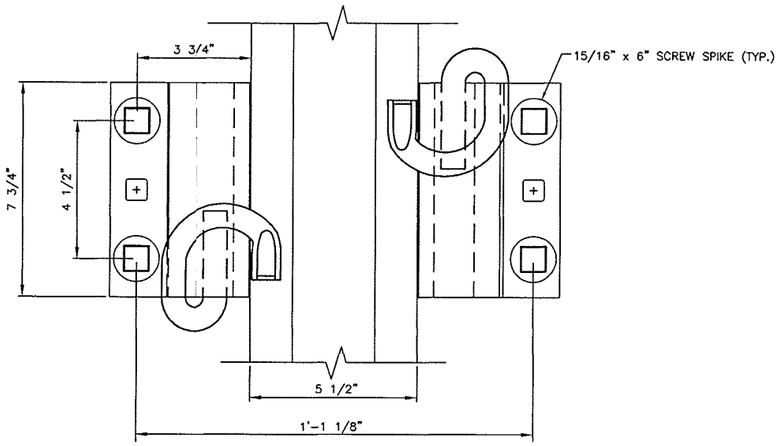
WALSH GRANITE

THE WALSH BARLETTA GRANITE

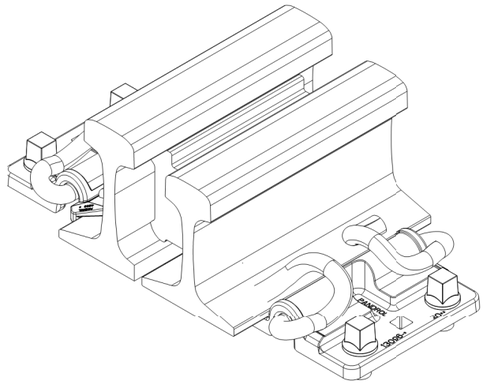
Joint Venture Team

115/132 RESTRAINING RAIL DETAILS

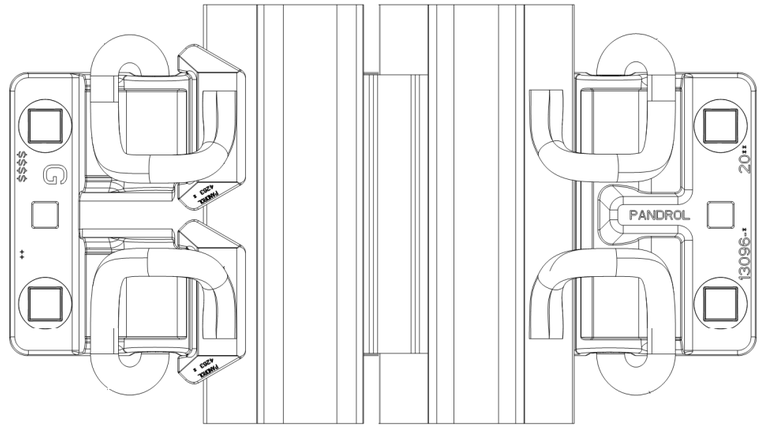
DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET 000-K-0105



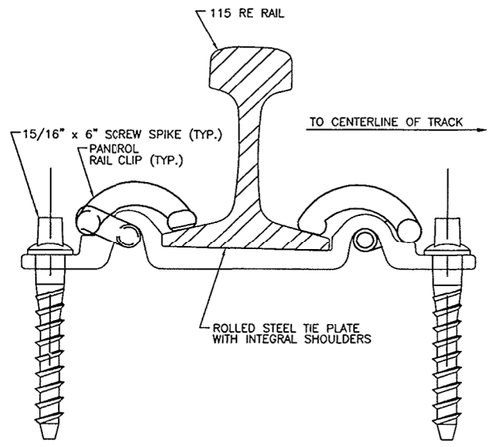
PLAN
NO SCALE



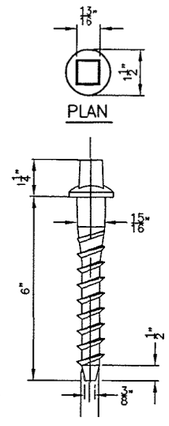
ISOMETRIC



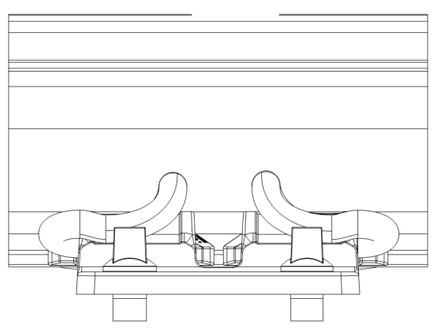
PLAN



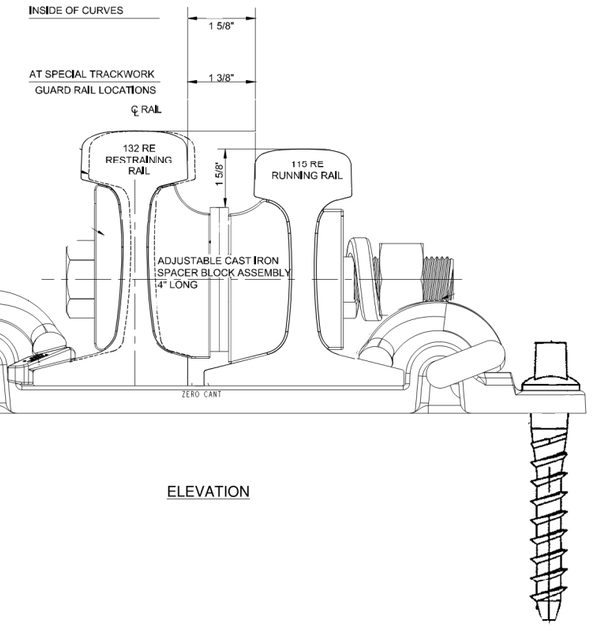
ELEVATION – PANDROL TIE PLATE ASSEMBLY
NO SCALE



ELEVATION
15/16" X 6" SCREW SPIKE
NO SCALE

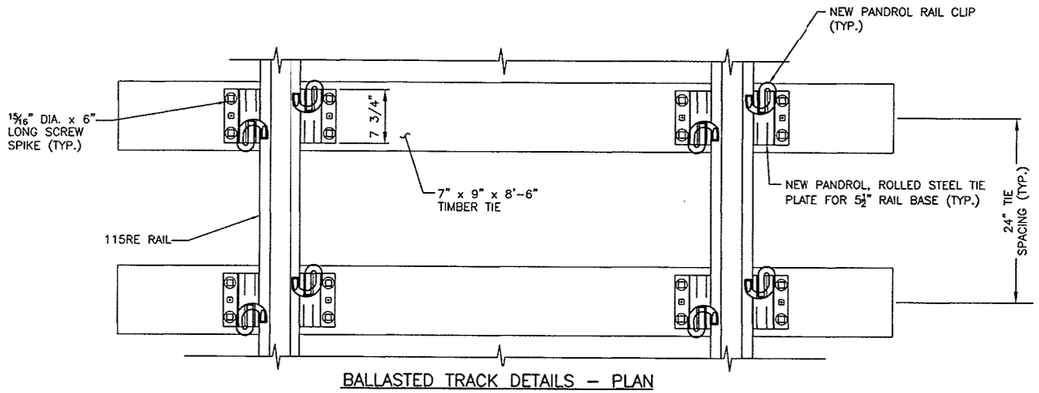


GUAGE SIDE



ELEVATION

PANDROL ADJUSTABLE RESTRAINING RAIL PLATE
NO SCALE



BALLASTED TRACK DETAILS – PLAN
NO SCALE

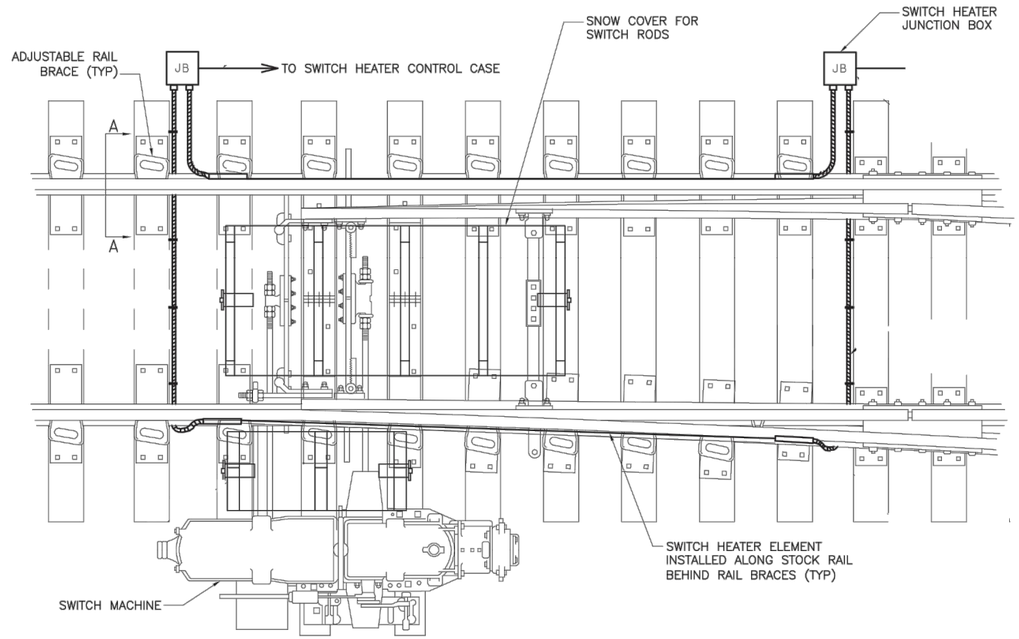
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

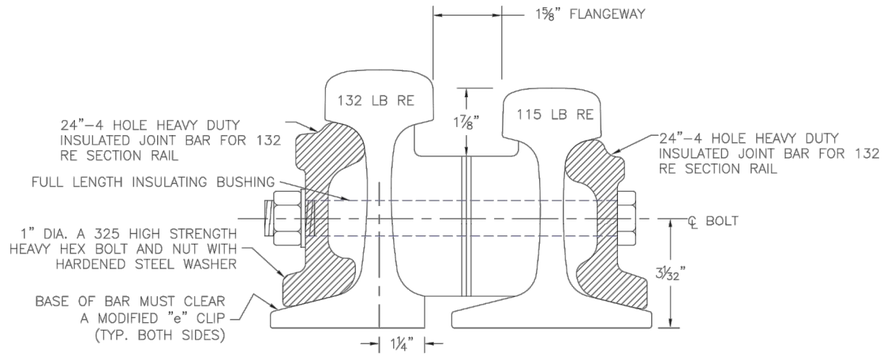
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

TRACK FASTENING SYSTEM DETAILS

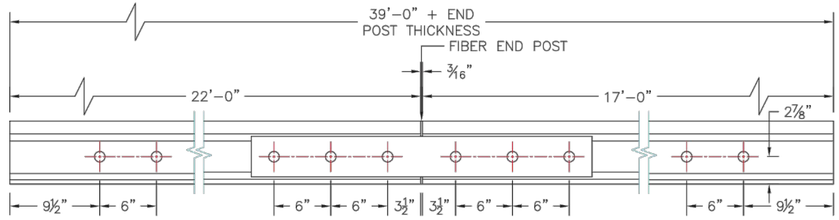
DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET 000-K-0106

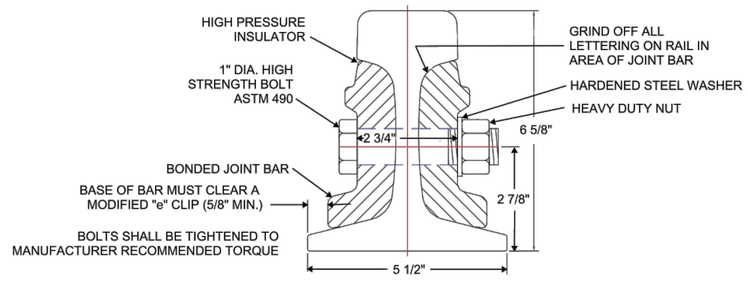


SWITCH HEATER INSTALLATION
NO SCALE


1⅝" FLANGEWAY
132 LB RE
115 LB RE
1⅞"
24"–4 HOLE HEAVY DUTY INSULATED JOINT BAR FOR 132 RE SECTION RAIL
24"–4 HOLE HEAVY DUTY INSULATED JOINT BAR FOR 132 RE SECTION RAIL
FULL LENGTH INSULATING BUSHING
℄ BOLT
1" DIA. A 325 HIGH STRENGTH HEAVY HEX BOLT AND NUT WITH HARDENED STEEL WASHER
3⅛2"
BASE OF BAR MUST CLEAR A MODIFIED "e" CLIP (TYP. BOTH SIDES)
1¼"

DOUBLE INSULATION JOINT
NO SCALE




HIGH PRESSURE INSULATOR
1" DIA. HIGH STRENGTH BOLT ASTM 490
GRIND OFF ALL LETTERING ON RAIL IN AREA OF JOINT BAR
HARDENED STEEL WASHER
HEAVY DUTY NUT
2 3/4"
6 5/8"
BONDED JOINT BAR
BASE OF BAR MUST CLEAR A MODIFIED "e" CLIP (5/8" MIN.)
2 7/8"
BOLTS SHALL BE TIGHTENED TO MANUFACTURER RECOMMENDED TORQUE
5 1/2"

BONDED INSULATION JOINT
NO SCALE

NOTES:

1. SWITCH HEATERS TO BE INSTALLED ON ALL SWITCHES, ELECTRIC AND HAND THROWN

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
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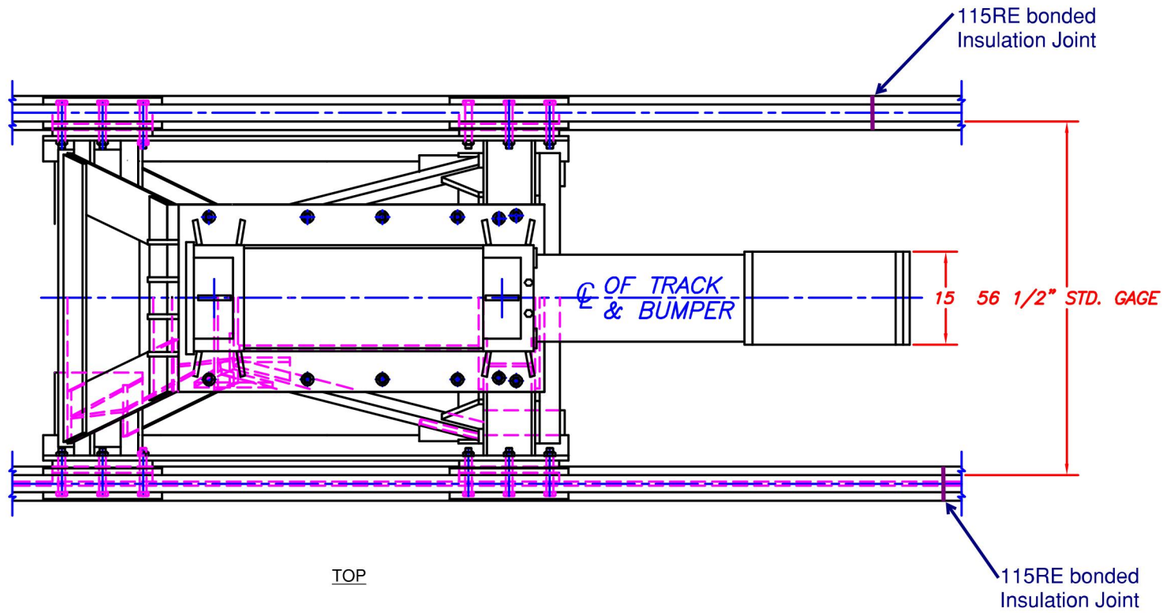
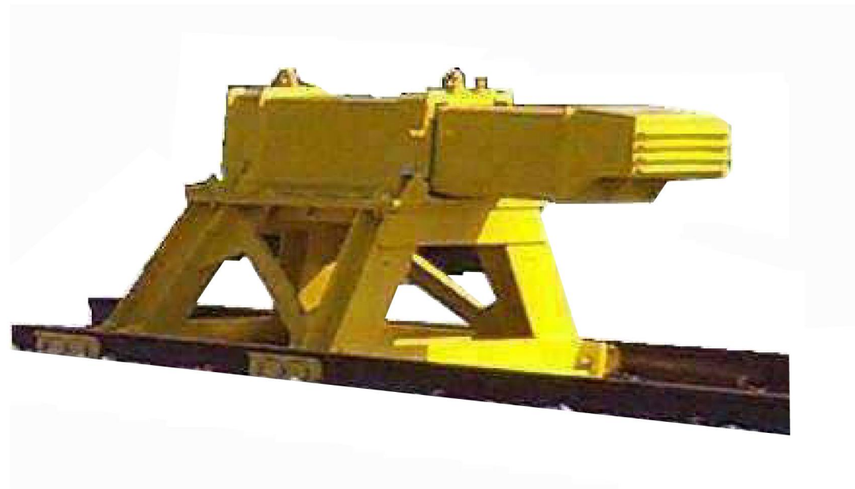
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

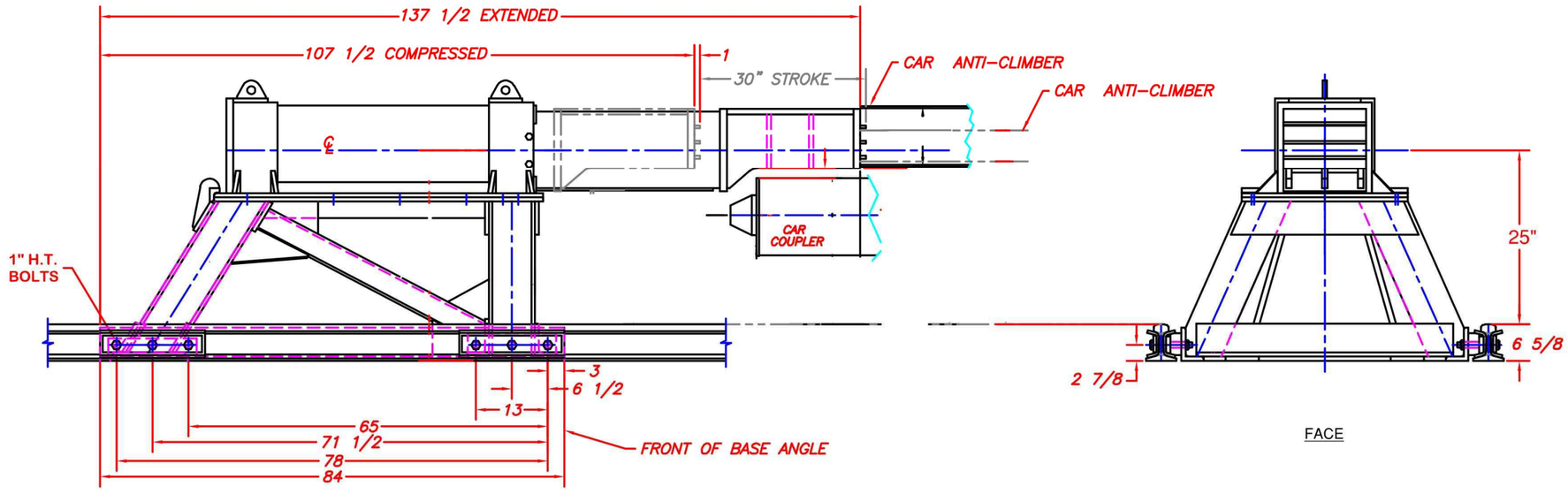
TRACK AND SIGNAL INTERFACE DETAILS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET 000-K-0107



TOP





SIDE

FACE

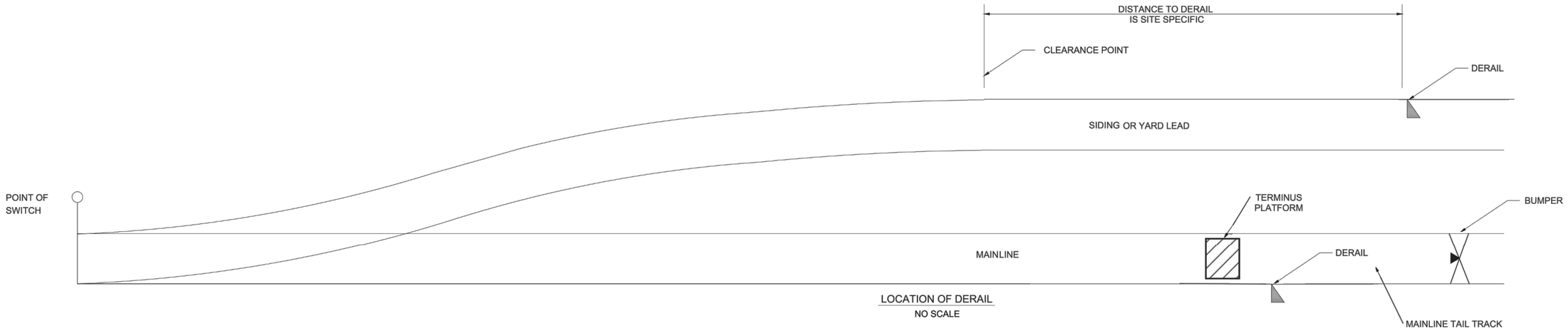
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

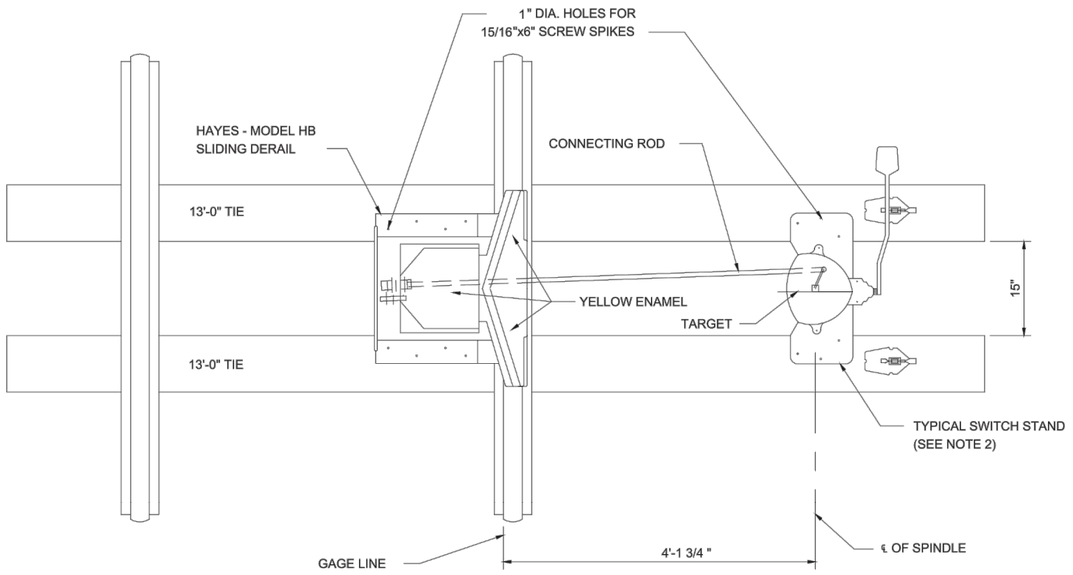
LRV HYDRAULIC BUMPER DETAILS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET 000-K-0108



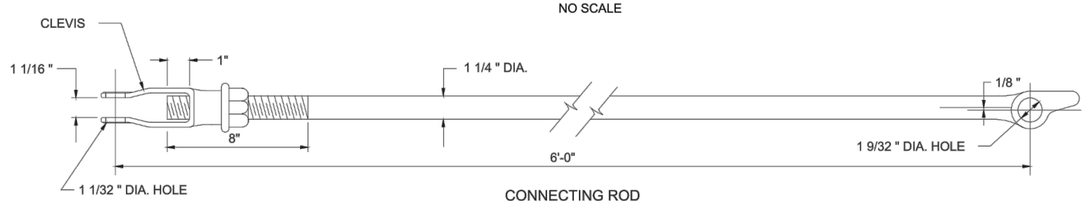
LOCATION OF DERAIL

NO SCALE



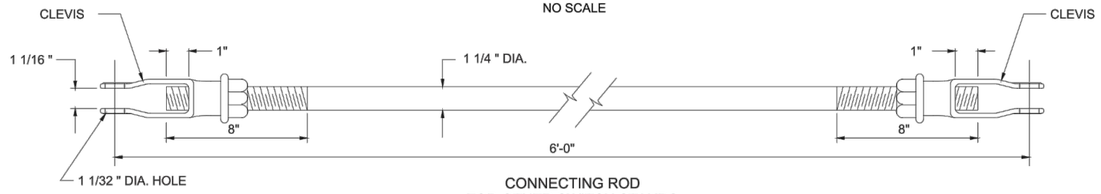
SWITCH STAND AND DERAIL INSTALLATION

NO SCALE



CONNECTING ROD
FOR NEW CENTURY SWITCH STAND

NO SCALE



CONNECTING ROD
FOR OTHER SWITCH STANDS

NO SCALE

NOTES:

1. THE FOLLOWING SWITCH STAND IS TO BE USED TO OPERATE DERAIL- NEW CENTURY SWITCH STAND, MODEL 50-A AS MANUFACTURED BY BETHLEHEM STEEL OR APPROVED EQUAL.
2. OPERATING ROD TO BE IN TENSION, WITH RED TARGET PERPENDICULAR TO THE RAIL, WHEN THE DERAIL IS IN THE NORMAL POSITION.
3. DERAILS SHALL BE DOUBLE ENDED DERAILING FLANGES WHICH WILL OPERATE AS EITHER LEFT OR RIGHT HAND DERAILS.
4. ALL DERAILS TO ACCOMMODATE PADLOCKS ON BOTH ENDS, ONE A SWITCH LOCK; THE OTHER A PRIVATE LOCK.
5. REFLECTORIZED DERAIL BANNERS SHALL BE USED
6. REFLECTORIZED SHEETING MATERIAL SHALL CONFORM AND BE APPLIED IN ACCORDANCE WITH CURRENT AND APPLICABLE MHD STANDARDS.
7. BANNERS SHALL BE FABRICATED FROM 7 GAGE GALVANIZED STEEL SHEET AS ONE CONTIGUOUS PIECE (NO JOINTS OR SEAMS ALLOWED).
8 SHADE OF COLORATION SHALL BE APPROVED BY THE MBTA

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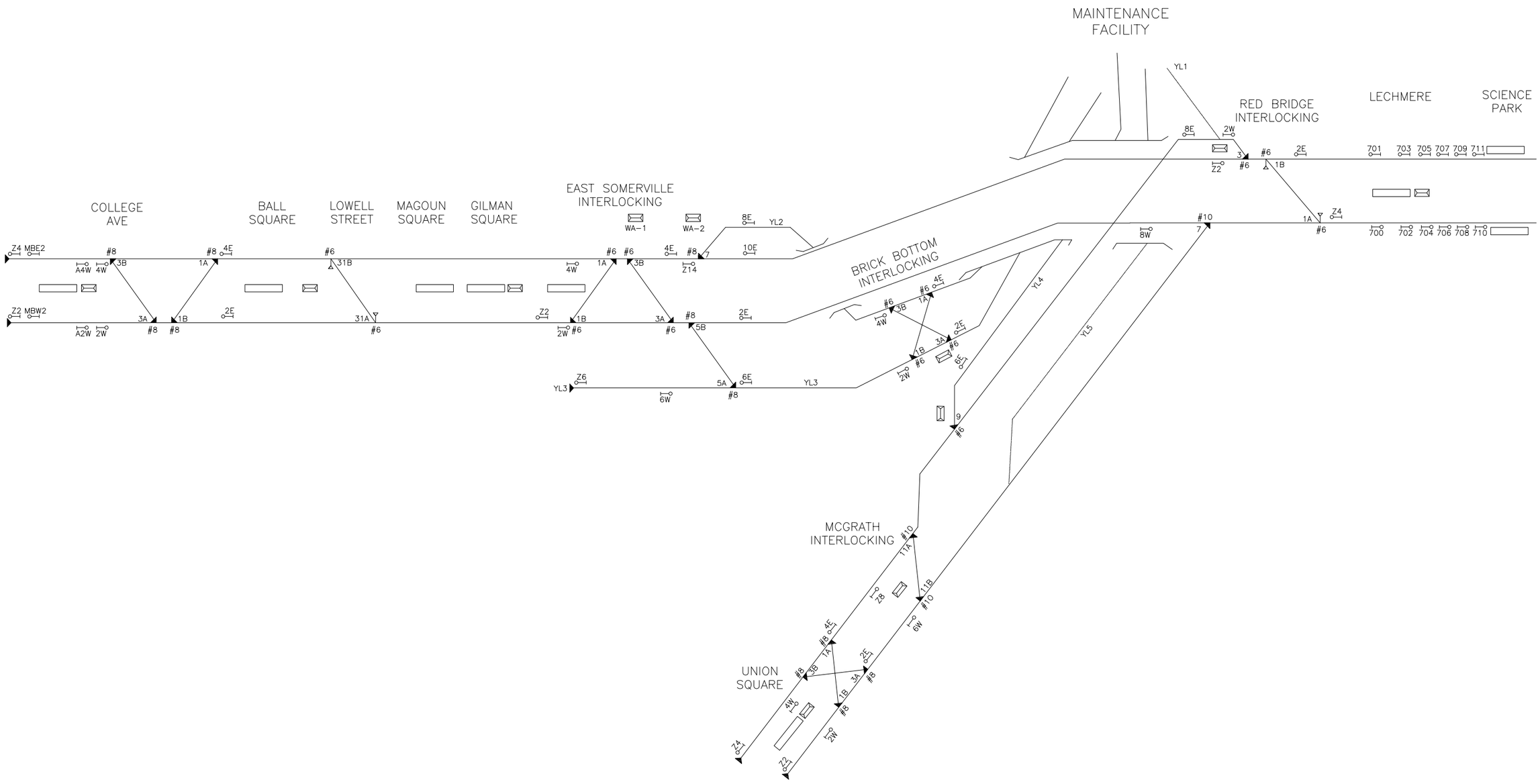
WALSH GRANITE

THE WALSH BARLETTA GRANITE
Joint Venture Team

SLIDING BLOCK DERAIL DETAILS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-0109



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
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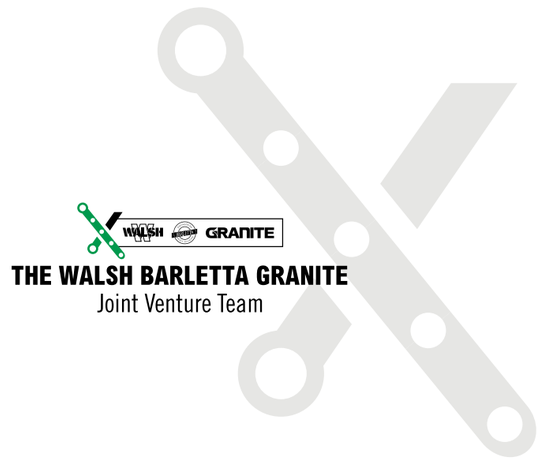
THE WALSH BARLETTA GRANITE
Joint Venture Team

OVERALL SIGNAL SYSTEM SCHEMATIC

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-SC-1001**

ELEVATED GUIDEWAY AND STRUCTURES
ALONG THE GUIDEWAY



THE WALSH BARLETTA GRANITE
Joint Venture Team

4.2 Elevated Guideway and Structures along the Guideway

WBG evaluated all proposed guideways, bridges, retaining walls, and noise walls. Each structure was first reviewed for function, layout, and compliance, and then modified or redesigned to provide an optimized solution. Material selection, available steel, constructability, traffic control, and agency requirements were just some of the design considerations. The knowledge gained from this effort will be coupled with design and construction expertise to provide structures that can be built while minimizing impacts to the surrounding community.

A. STRUCTURES ALONG GUIDEWAY

Conformance to Structural Requirements

Section 8 of the Technical Provisions details the design criteria, standards, methodology, and other structural requirements for the various structural elements within the project limits including viaducts, railroad bridges, roadway and pedestrian bridges, underpasses, retaining walls, and noise walls. We will comply with the requirements for each of these elements. The applicable criteria and standards vary by element but are typically a combination of the latest additions to the following:

- MBTA Guide Specifications for Structural Design of Rapid Transit and Light Rail Structures (Light Rail Code)
- MBTA MOW Green Line – Light Rail Transit, Track Maintenance and Safety Standards
- MBTA Standard Specifications, Construction
- MBTA Railroad Operations Commuter Rail Design Standards Manual, Volumes I and II
- MBTA Railroad Operations Book of Standard Plans, Track and Roadway
- AREMA Manual for the Railway Engineering
- Load and Resistance Factor Design (LRFD) Bridge Manual, Parts I, II, and III of MassDOT
- AASHTO – various specifications and guidelines
- Massachusetts Building Code

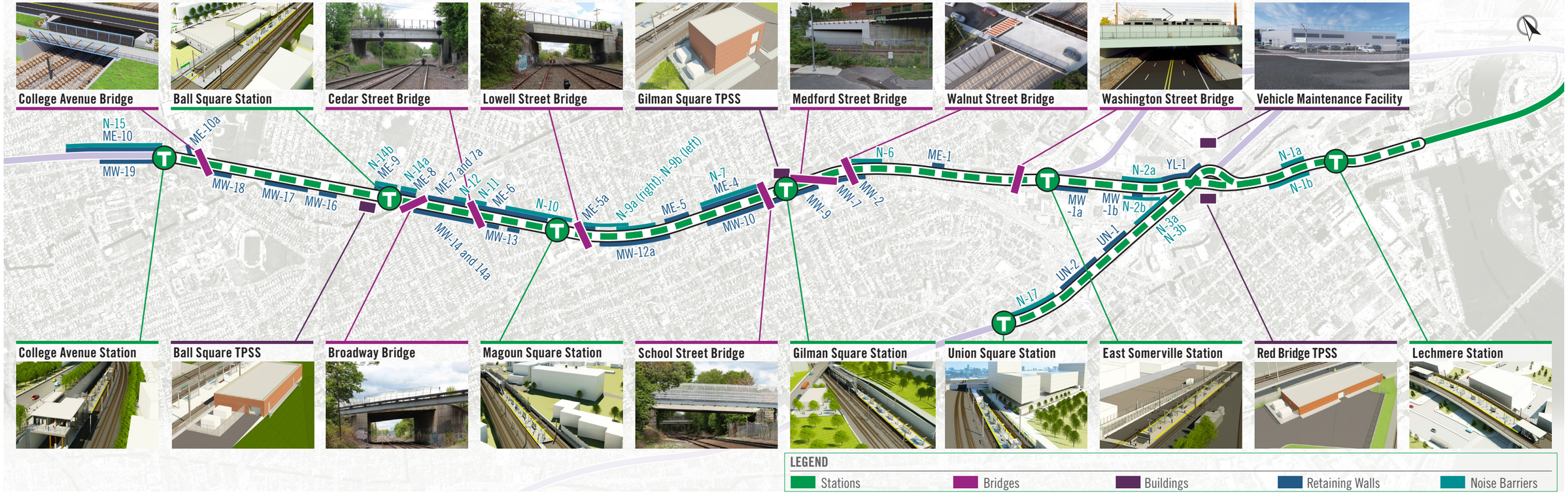
Our approach to conforming to various structural requirements is detailed in the following sections.

Design Criteria and Applicable Standards

Elevated Guideway (Viaducts): The elevated guideway (viaducts) elements were designed using the Load Factor Design (LFD) method specified in the Light Rail Code, with detailing for structural elements complying with MassDOT's LRFD Bridge Manual. The Lechmere and Medford Branch viaducts were designed to support eastbound and westbound tracks, while the Union Square eastbound and westbound viaducts were designed to hold single tracks. Loads were determined in accordance with the Light Rail Code, such as revenue vehicles and non-revenue vehicles, noise barriers and wind screens, handrails, guardrails, and other protective railings, as well as earthquake forces. Seismic analysis will be performed following AASHTO Division 1A, Article 4.2 Procedure 3.

Railroad Bridge: The structural steel elements of the Washington Street bridge were designed using the Allowable Stress Design (ASD) method per the AREMA manual. The LRFD method was used for the concrete elements.

GLX structures. Evaluating proposed all structures allowed WBG to gain a full understanding of the details for each to plan and sequence the work.



Roadway and Pedestrian Bridges/Underpasses: Roadway and pedestrian bridges, as well as the underpass at Medford Street, were designed using the LRFD method in accordance with the AASHTO specifications and guidelines specified in Sections 8.4.3.1 and 8.6.3.1. Two new pedestrian bridges will be constructed, one at the College Avenue Station and the second supporting the Community Path at the intersection with School Street. Details of the various components will comply with LRFD Bridge Manual.

Retaining Walls: Retaining walls were designed using the LRFD Bridge Manual. We determined loads according to AREMA, the Light Rail Code, the AASHTO Standard Specifications, and the Massachusetts State Building Code, where each apply, according to Section 8.1.3.3 of the Technical Provisions. Wall components were designed in accordance with AISC and ACI codes where applicable; otherwise, according to FHWA standards. Design (including corrosion protection) will be completed using wall type specific procedures from the FHWA, except where superseded by a reference from the Technical Provisions.

Noise Walls: The design methodology for noise barriers varies by component. WBG designed the structural steel elements using the ASD method, the concrete elements using LFD, and the foundation elements using LRFD.

Serviceability Criteria

The viaduct elements were designed so that the maximum deflection due to live loads, plus impact of revenue trains, does not exceed 1/1000 of the respective span length. Similarly, the maximum deflection due to live loads, plus impact of non-revenue trains, were designed to not exceed 1/800 of the respective span length. Additionally, the Lechmere viaduct was designed in accordance with the level boarding requirements of the Lechmere Station platform. Structures typically were designed through a limiting equilibrium analysis to determine geometry to meet the required safety factor. Using this geometry, geotechnical analyses will be performed to ensure global stability of the overall slope during final design and to evaluate if expected settlement is within acceptable serviceability limits. In the case of flexible retaining walls, a p-y spring type analysis will be conducted to evaluate expected deflections and to develop an economical design of the wall elements.

Where there are adjacent structures, WBG will use specific deflection criteria. Otherwise, movements will be limited to superficial damage according to FHWA guidelines, as required per Technical Provisions Section 15.1.3.1.

Where possible, an anchored wall system will be used, which provides better deflection control than cantilever walls. For soldier pile and lagging walls, which tend to have higher deflections due to the possibility of soil loss, WBG will include provisions for backpacking the lagging. Louvers, hay placement, or cement-mixed packing soil can be included as conditions dictate.

Drainage and Waterproofing System

WBG designed all retaining wall systems to prevent pore pressure build-up behind the wall and to allow water to flow to a drainage system on the excavated side of the wall. See Figure 4.2-1 for a description of our proposed drainage and waterproofing systems.

Right-of-Way

All viaduct structures can be constructed within the right-of-way, including temporary easements provided through third party agreements, except for the replacement of the existing Lechmere viaduct sections which will require City of Cambridge and MassDOT cooperation on necessary lane closures to dismantle the old and erect the new viaduct to Lechmere Station. The viaduct erection across the train yard with the two-track restriction will be strategically challenging, but will be performed without adverse impact to rail traffic. All work involving abutters and third party agreement holders, such as the restrictive environs of the viaduct coming from Lechmere, will be closely coordinated with those parties so they will be aware of all temporary works to ensure all potential impacts to either party are mitigated through proper planning and scheduling.

Frost Heave

We will locate the base of all structures below the depth of frost penetration or remove susceptible materials to below the depth of frost penetration and replace them with non susceptible materials to mitigate frost heave. WBG will never commence construction of works upon frozen subgrades.

Structural Drawings

Structural drawings are provided at the end of Section 4.2.

B. BRIDGE AND UNDERPASS STRUCTURES

General Approach to Meeting Requirements

WBG's general approach to bridge and underpass design and construction focuses on innovative approaches that will mitigate the impact to the community using surface road pedestrian, bicycling and vehicular travel paths, while producing sensitive, accommodating, and durable final connectivity features to the GLX system expansion. We will comply with Volume 2 Technical Provisions, Sections 8.0 and 15.0, as modified by approved ATCs.

Through our design efforts thus far, WBG has eliminated the need for an underpass at Walnut Street by designing a retaining wall system that will allow the Community Path to rise to street level at this intersection. At Broadway, our full-height drilled shaft, concrete-faced abutment wall will minimize the time necessary to construct the new bridge while reducing work at track level. These design improvements shorten the overall construction impact to the local community while providing a cleaner, aesthetically pleasing end user product.

Coordinating with the Cities of Somerville and Medford for the necessary traffic detours, lane closures, and intersection improvements is paramount to our work on these structures. WBG has already designated the sequencing and priority of these works in our design deliverables and construction schedule to fully comply with the essential contract requirements, ensuring that adjacent bridges are not simultaneously closed. We intend to maximize the construction operations performed at, under, and near the bridge/underpass work zones, so that minimal construction operations linger behind the major work components, allowing full return of areas to everyday community use.

Figure 4.2-1 Drainage and waterproofing systems, application, and benefit.

TYPE	THE WBG APPLICATION	BENEFIT TO THE PROJECT
Retaining Wall Systems	» Design to allow water to flow to a drainage system on the wall's excavated side » Avoid uncertainties of long-term performance by limiting design of seepage cutoffs	**Prevents build-up of pore pressures behind the wall** **Ensures long-term performance**
Permanent Drainage Systems	» Use drainage fabric or free draining aggregate on the back face of the permanent wall » Use drainage fabric that is either nonwoven fabric when in contact with soil or drainage board when finer materials are likely within the existing embankment being closed » Use pea gravel for free drainage aggregate	**Prevents build-up of pore pressures behind the wall** **Ensures long-term performance**
Bottom-Up Constructed Walls *(cast-in-place, precast block types, mechanically stabilized earth, etc.)*	» Use drainage fabric in conjunction with free draining aggregate for the construction sequence	**Allows the aggregate to be installed with backfill lifts** **Prevents build-up of pore pressures behind the wall** **Ensures long-term performance**
Top-Down Constructed Walls *(solider pile and lagging, soil nail, secant pile, etc.)*	» Use pervious wall systems and non-woven textiles	**Eliminates deformations behind the wall caused by installation of free draining aggregates between the wall elements and the retained soil** **Eliminates impacts to the construction sequence**
Continuous Drilled Shaft Walls *(secant pile, tangent pile)*	» Incorporate drain hole features through the concrete elements » Cover the face of the wall with drainage fabric behind the permanent facing » For secant pile walls, incorporate shorter length unreinforced elements (where structural requirements allow) that extend slightly below the bottom of the excavation	**Directs underseepage to the drainage system** **Prevents build-up of pore pressures behind the wall** **Ensures long-term performance**

Figure 4.2-2 Lechmere Viaduct. A section of the historic Lechmere Viaduct will be salvaged and restored to retain a direct link to the past.

Figure 4.2-3 Viaduct over yard. View of the Union Square westbound elevated guideway (viaduct), VMF yard, and Vehicle Maintenance Building.

The renderings in Figure 4.2-2 and Figure 4.2-3 are representative views of new viaducts. At Lechmere, a section of the historic viaduct will be retained to provide continuity with the past. The section to be retained will be protected, stored, refurbished, and re-used so that it seamlessly fits with the final built condition.

The rendering in Figure 4.2-3 shows one of the elevated guideways in the foreground and the Vehicle Maintenance Facility (VMF) yard in the background. The three yard leads will provide connections to the Green Line branches, and the VMB in the background will be the focal point of the new site.

ATC 5 replaces portions of the overhead viaducts with at-grade guideway. The revised guideway will be constructed on a subgrade consisting of EPS blocks wrapped in gasoline-resistant geomembrane, within cast-in-place concrete walls. The EPS blocks will bear on a 6-inch sand leveling layer and will be covered with 3 feet of ballast and an 8-inch concrete distribution slab. This ATC eliminates foundations and reduces overall construction impacts at affected locations.

Modifying Bridges & Constructing Underpasses

WBG's design ensures that necessary geotechnical information is accumulated, reviewed, and applied to the final design elements for the work. Once designs are prepared in full accord with the design requirements of Volume 2, Section 8 and submitted for approval, our engineers will be ready for "face-to-face" comment review sessions that will include over-the shoulder reviews with MBTA and MassDOT staff to expedite the approval process. ATC 2 eliminates one pedestrian overpass to bring the Walnut Street Community Path from track level to street grade. In the field, WBG will follow strict guidelines, as outlined in Volume 2, Section 15 of the Technical Provisions, establishing geotechnical monitoring protocols and Section 6 requirements for pre-construction surveys. Additionally, all bridge area work will be planned with stakeholder input and performed accordingly so that adverse effects to street level circulation and revenue train service are minimized.

Proposed Track Structure/Rail Fastening Systems

All proposed track work within the limits of new underpass structures at Medford and School Streets will be constructed independently as a standard wood tie and ballasted track type system conforming to MBTA standards and relevant GLX technical provisions. The continuity provided by a standard ballasted track and resilient fastener system throughout an underpass structure allows for unobstructed ground level, non-specialized maintenance activities of all support systems including track, catenary, signal, and communications lines. Additionally, the track's thermal expansion capability, attained through proper rail destressing, allows the track to move throughout typical day-night and seasonal thermal cycles without the risk of heat-induced rail kinking or cold weather related rail breaks or pull-aparts. While the new underpass structures will typically be constructed with a concrete floor below the frost line, the ballasted track system does not fasten to the structure, and is the right choice to ensure that any expansion is controlled and that the MBTA receives a safe, regulatory compliant rail system.

Waterproofing System Approach

The proposed bridge deck waterproofing system will conform to the current MassDOT Specification Section 965 Special Provision for Membrane Waterproofing (Spray Applied). The system will be as currently approved by MassDOT and applied by qualified/certified personnel. The spray applied membrane waterproofing for the viaduct bridge decks will be a similar system and conform to MBTA Specifications and approvals.

The work associated with the underpass construction will provide some of the most challenging locations for membrane waterproofing systems. As such, to ensure the highest quality installation, WBG will be using an integrated membrane system that includes pre-applied applications, where the membrane is placed on substrate and then the concrete slab or wall is poured against it. This method will be used for base slabs and existing abutments or drilled shaft walls where concrete facing will be placed as the finished wall of the underpass. Accessible areas, such as underpass roofs, will have the membrane applied post-concrete placement and be properly overlapped and joined to the wall membranes.

At the Washington Street bridge, a ballasted deck structure, spray-applied continuous membrane waterproofing will be applied to provide an impenetrable barrier to water (Figure 4.2-4).

Site-Specific Approach to Meeting Requirements

In this section, we describe the overall design and construction approach for bridges along the right-of-way. The descriptions for Walnut Street bridge and College Avenue bridge can be found on page 4-28.

Washington Street Bridge

The existing rail bridge over Washington Street consists of four three-span steel through-girder superstructure units with ballasted track. The proposed replacement bridge consists of a single span at 110 feet, supported by drilled shafts with concrete caps at the abutments. The existing granite abutment top courses will be removed, with the lower portions remaining in place to act as abutment retaining walls. The proposed superstructure units are composed of steel through-girders, with steel plates supporting track ballast.

The proposed superstructure also supports the Community Path at the track level. U-back wingwalls are proposed, with the southwest wingwall also supporting a cantilevered slab for the Community Path. The steel superstructure through-girders have already been fabricated, and are stockpiled nearby for assembly and erection.

Proposed staging takes advantage of existing bridge structures for temporarily shifting train traffic during demolition and construction of the proposed bridges. The design team performed an initial evaluation to determine that the existing structure is suitable for use in this way.

In addition to reducing construction work along the guideway, using full-height drilled shafts as the bridge pier supports minimizes the amount of temporary support of excavation and the corresponding duration of work and impacts to the Washington Street roadway and pedestrian paths in this area.

Figure 4.2-4 Bridge deck waterproofing. Waterproofing application on Barletta's Neponset River Bridge Replacement project for the MBTA.

Figure 4.2-5 Soil nail walls. Soil nail walls at Jacobs' Winter Street project are similar to those that will be used at the Lowell Street Bridge.

Medford Street Bridge

At the Medford Street bridge, an underpass behind the existing southern abutment must be constructed to accommodate the inbound trackway of the GLX and the Community Path.

WBG will commence the construction of the underpass with the installation of drilled shafts south of the existing bridge that will serve as earth retention and as the southern wall of the underpass. Simultaneously, work will be performed on modifying the supports of the existing utility bridge onto the Medford bridge, so that excavation for the underpass can commence.

The road will be closed during underpass construction. Once the excavation is completed behind the existing southern abutment, shear dowels and micropiles will be installed and a full-width floor slab will be placed, essentially bridging from the new, drilled shaft wall to the existing abutment. WBG will construct a CIP facing wall at the drilled shafts and a structural support wall at the existing abutment, followed by the CIP underpass roof. Throughout the concrete construction, we will take care to encapsulate the underpass CIP structure with a uniform waterproofing system that will ensure the integrity of the completed structure.

To bring the excavation back to grade and restore the roadway, edge walls will be installed to provide retainage of the earth and paving, and to support the bridge railing.

School Street Bridge

WBG will implement our approved ATC 3 at School Street. With this method, we are constructing a single span that crosses all four tracks, rather than adding to the existing superstructure. The west bridge abutment will be removed, and a new west bridge abutment will be constructed, providing a longer bridge span of 93.7 feet, compared to the existing 73.5-foot bridge span. This will increase the bridge opening to accommodate the new track. The proposed bridge is composed of composite steel plate girders supporting sidewalks, parking, vehicular traffic, and relocated utilities. The proposed west abutment will be a high cantilever type. The existing east abutment cap will be modified to support the new superstructure. The School Street railway crossing will be fully closed to vehicular traffic during construction and closed to rail traffic during key construction operations, such as girder erection.

The work at the School Street and Medford Street bridges will be sequential to avoid closing adjacent surface routes, and to mitigate vehicle and pedestrian access impacts to the community. Similar to the work at Medford Street, the southern retaining wall for the underpass will be a drilled shaft, concrete-faced wall. Construction will begin with the installation of the new southern retaining wall concurrent with the construction of a temporary support beneath the School Street bridge. This will allow removal and replacement of the existing southern abutment. Work will then continue with removing the existing south abutment and excavating the earth behind it. Concurrent with the CIP facing of the drilled shaft retaining wall, a new pier and spread footing will be constructed to replace the south abutment. A reinforced concrete base slab and roof will complete the underpass.

Cedar Street Bridge

To support the embankment and adjacent property at this location during demolition of the existing southeast wingwall, WBG will install a new cantilevered pile retaining wall with a setback to provide sufficient clearance for the new GLX trackway. Additionally, since the Cedar Street bridge's existing south abutment wall is close to the rail track, a refuge niche will be cut into the wall to provide the necessary safe haven for track walkers to safely conduct their work activities.

Lowell Street Bridge

Beneath the Lowell Street bridge, the previous bridge's granite block wall remains that served as the south abutment. The current bridge is supported on the south side by a drilled shaft abutment that is located to the south of the granite wall. As part of the widening of the right-of-way to accommodate the GLX track alignment, the old granite abutment will be removed in a top down fashion, with excavation and the installation of soil nails to reinforce the drilled shaft abutment proceeding in lifts until final grade is reached (Figure 4.2-5).

Upon completion of the work to prescribed subgrade, WBG will install a reinforced concrete facing wall at the soil nail-reinforced, drilled shaft abutment. Similarly, the existing wingwalls will be removed and replaced with new soil nail wingwalls with permanent concrete facing.

Broadway Bridge

The existing Broadway bridge is a single span bridge that can only accommodate the existing NHML alignment. To improve the drainage system and allow the addition of the GLX tracks and at-grade Community Path, the bridge must be removed, including currently buried granite abutments from the previous bridge at this location. The new bridge will be a two-span bridge with an overall span of 150 feet and a width of 53 feet. The single bridge pier will be located between the GLX east and westbound tracks.

To minimize the overall construction timeframe and impact to ongoing commuter rail operations, WBG will use full-height drilled shafts for both abutments on this bridge. Upon completion of the installation of the drilled shafts, WBG will demolish the existing Broadway bridge and the buried previous bridge structures in their entirety, with special care taken to ensure that the medical building foundation wall is not impacted (currently a portion of the northeast wingwall is connected to this building).

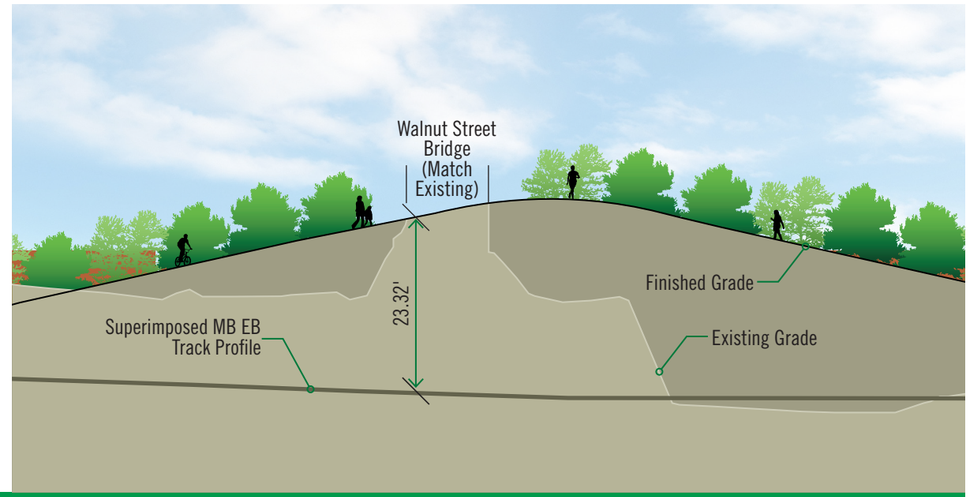
Once demolition is complete, WBG will shift the existing commuter rail away from the northern abutment to allow the deep drainage installation. All adjacent retaining and noise wall foundations will then be completed, allowing the commuter rail to be repositioned to its final alignment in this area. Work on the southern abutment and center pier will follow, with the erection of the superstructure occurring once all substructure work is complete.

Walnut Street Bridge

Through ATC 2, WBG eliminated the need for a pedestrian underpass at Walnut Street through the incorporation of additional sections of retaining wall that will allow the community path to come to street level at Walnut Street along with minor track realignment beneath the existing bridge.

This design revision will eliminate the need to close Walnut Street Bridge for the work associated with the underpass construction and will also eliminate the need to disrupt the major water supply through a 48-inch MWRA water main at this location.

To install the revised retaining wall system, WBG will use temporary earthen ramps within the ROW to create work platforms for the drilling rigs to access the designed top of shaft elevation during installation operations.



Proposed Walnut Street Bridge. WBG's ATC 2 eliminates the pedestrian underpass, improving track sight lines and increasing pedestrian safety.

College Avenue Bridge

The work at the College Avenue bridge consists of two separate and distinct work elements, the first is a new pedestrian bridge located west of the existing MWRA utility bridge and the second is the creation of a traffic turning lane on the west side of the bridge in the area currently occupied by a raised sidewalk.

WBG will be working on the major retaining walls north of the College Avenue bridge, on both sides of the alignment, during the early phases of our work on the Project. Once the major work on the Boston Avenue side is completed, which consists of the installation of a substantial soil nail, shotcrete, and formed face concrete retaining wall, we will commence work in earnest on the College Avenue Pedestrian bridge. First, WBG will trim the MWRA utility bridge wingwalls, and then perform the necessary SOE to allow the construction of the CIP spread footing and abutment walls. The planned pedestrian bridge is a prefabricated truss bridge, which will be set in place as a single piece.

The turning lane work on the existing bridge consists of sidewalk removal, bridge deck reconstruction, and perimeter railing curbing and reinstallation. WBG intends to perform this work after the pedestrian bridge is fully operational and all the traffic signal revisions are in place at the College Avenue/Boston Avenue intersection.

Proposed College Avenue Pedestrian Bridge. The above graphics show one possible prefabricated truss suitable for this location.

Bridge Drawings

Drawings are located at the end of Section 4.2.

WBG BENEFIT HIGHLIGHTS FOR STRUCTURES ALONG THE GUIDEWAY

Benefits of WBG's overall design and construction approach for bridges along the right-of-way including the Walnut Street and College Avenue bridges, include:

Pedestrian Safety. WBG ensures local pedestrians will experience an environment that enhances safety.

Access. WBG improves access to the Community Path by allowing the path to rise to street level.

Track Sight Lines. WBG improves track sight lines through minor track realignment.

Long-Term Maintenance. WBG's structures approach reduces long-term bridge maintenance.

C. GEOTECHNICAL ENGINEERING

The geotechnical engineering for the Project includes subsurface investigations and interpretations, geotechnical analyses, and preparation of design and construction recommendations for the foundation design of train stations, Transportation Building, Vehicle Maintenance Building (VMB), traction power substations, bridges, viaducts, retaining walls, slopes, embankments, and other minor structures (i.e., catenary poles). The geotechnical design and recommendations will also include support of excavations and groundwater control during construction.

Geotechnical Conditions, Constraints, Concerns, and Issues

The borings have identified the following subsurface strata: existing fill, organic soils, fine-grained soils, granular soils, and weathered bedrock. Bedrock is the only layer present at all locations. The depth of the existing fill varies across the project site and is more than 20 feet thick at some proposed structure locations. The existing fill is generally considered unsuitable as foundation bearing material for spread footings. It typically requires undercut and replacement by structural fill beneath the footings.

The organic soils are generally very soft with typical depths 10 to 20 feet below grade. The organic soils generally need to be removed and replaced below proposed spread footings. Most ground improvement techniques such as stone columns do not work well with soft organics; in such cases deep foundations may be required. The fine-grained soils consist of very soft to stiff silt and clay. For a shallow foundation option, the settlement estimate in the fine-grained soils is critical as the serviceability is likely to control the foundation design. Most granular soils encountered are medium dense to very dense in nature and are generally considered suitable materials for foundation bearing, especially the dense glacial tills. The bedrock generally consists of gray, weak to strong, severely to slightly weathered, extremely fractured to sound, fine-grained Argillite. Very shallow weathered bedrock was encountered near College Avenue. Some of the excavations may involve hard rock excavations that require robust excavation techniques such as rock rippers or splitters.

The groundwater condition varies across the project locations, but shallow groundwater table (average 5 feet below grade) is typical. Many soils or groundwater at the project site may be contaminated with oil and/or hazardous materials. Therefore, the construction activities (earthwork, dewatering, etc.) will follow the oil and/or hazardous materials work plan. In addition, corrosivity tests indicated that many soils have a high corrosion potential. As a result, appropriate corrosion measures are needed to protect the buried concrete and steel structures including any tie-back systems. This is described in further detail in Section 4.1. Most of the construction will occur in urban areas with existing structures and utilities nearby.

Heavy construction equipment may create construction noise and vibrations. Among them, pile driving may create the most noise and ground vibrations. Therefore, a construction noise and vibration control plan is needed to minimize construction impacts.

A geotechnical instrumentation and monitoring plan is needed to monitor ground vibrations and deformation levels at adjacent structure and utility locations. Due to the space limitations such as right-of-way requirements, some of the earthwork may require temporary excavation support that may also need instrumentation/monitoring during excavations. In addition to the existing structures and utilities, future construction may also affect the stability of adjacent slopes. For instance, surface sloughing has occurred at slopes above the existing crib walls between Sycamore and Central Streets. The instrumentation and monitoring plan needs to address such areas with slope instability concerns.

Geotechnical and Hydrogeological Conditions used in Design Development

Numerous borings have been drilled along the proposed Medford and Union Square corridors and were used to summarize the overall geotechnical conditions in the following text.

Fill: Fill is present in most boring locations, primarily as a result of previous grading activities. The thickness varies from 0 to 30 feet at some locations. The fill consists mainly of granular materials such as sand and gravel; cobbles and boulders were noted at a few locations. Most fill areas were likely placed in an uncontrolled manner; SPT blow counts vary and indicate very loose to very dense consistency. Due to this irregularity, we do not recommend placing spread footings directly on the fill, but instead on newly installed select, compacted material after fill removal.

Organic Silt/Clay: Organic materials appear in the area along the Union Square Branch and south of Cross Street on the Medford Branch. Typically, it is 2 to 3 feet in thickness, but up to 10 feet in some locations. Typical depth is between 10 to 20 feet below grade. Due to the unsuitable nature of the material, very soft (weight-of-hammer) material will be removed and replaced below new footings or deep foundations will be used.

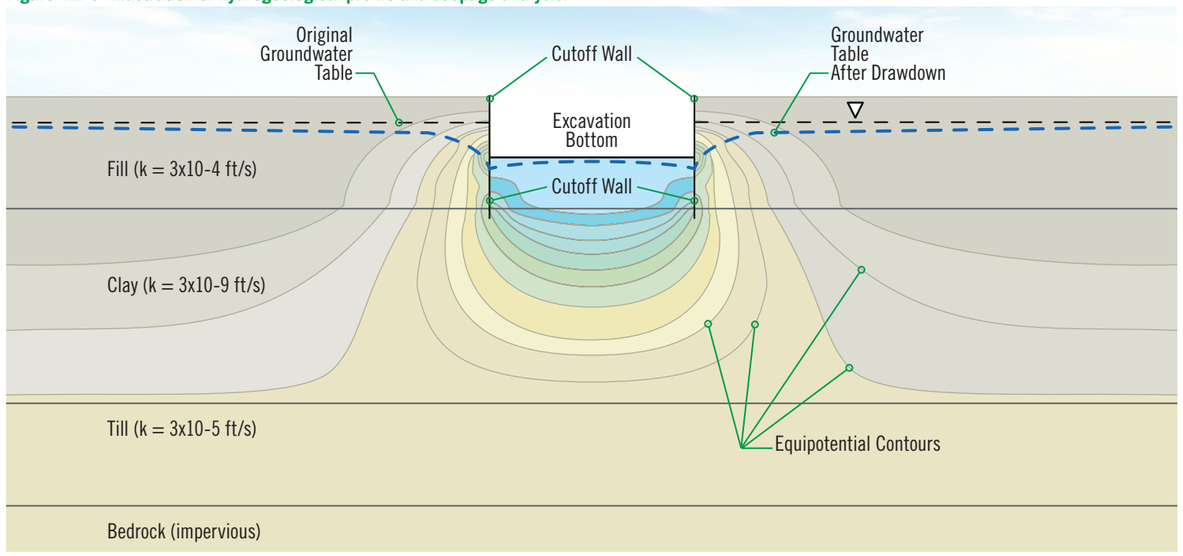
Silt/Clay: This cohesive layer appears to be continuous along the Union Square Branch with a typical thickness of 30 feet below the organics. The thickness tapers from 30 feet at Lechmere Station to 5 feet at Washington Street. Further north of Washington Street, this layer is only encountered in some locations. The N-value varies from weight-of-hammer to over 20. Generally, the soils are softer towards the south and stiffer further north along the corridor. For a spread footing option, the settlement evaluation of the clay layer is important. In some locations the clay/silt may need to be undercut, depending on depth, thickness, and preconsolidation stress.

Glacial Till/Sand: This layer is ordinarily located between bedrock and overlying soils and consists of dense to very dense sand and gravel. The depth is typically shallow toward the north and deeper toward the south. The depth of till is about 40 feet at Lechmere and Union Square Stations, and as shallow as 1-foot below grade at College Avenue. Thickness is between 10 to 20 feet, but may vary at different locations. Natural sand is encountered at some locations above the till or even above the silt/clay layer, and is typically medium dense to dense in consistency. This layer is generally competent as bearing materials for shallow foundations, or glacial till may be used as end bearing materials for deep foundations.

Weathered Bedrock: Below the glacial deposits, the bedrock consists of slightly to highly weathered Argillite with typical rock-quality designation ranging from 0 to 90%. The surface level of the rock varies significantly; generally deeper toward the south and shallower toward the north. The rock surface is about 80 to 100 feet below grade at Lechmere, 60 to 80 feet at Union Square Station, 20 to 40 feet at Gilman and 3 to 19 feet at College Avenue. The bedrock can be used for either shallow or deep foundation bearing materials. If the load demand is high, a rock socket may be used to increase foundation capacity.

The hydrogeological conditions also vary along the corridors, and the groundwater table is typically shallow with an average depth about 5 feet below grade. We will review the previously developed geotechnical and hydrogeological profiles at all major structure locations and develop site-specific recommendations for each structure based on our interpretation of the subsurface conditions. Figure 4.2-6 shows an example of a hydrogeological profile for a typical support of excavation. The soils are divided into layers with

Figure 4.2-6 Illustration of hydrogeological profile and seepage analysis.



assigned hydraulic conductivities. The initial groundwater table is based on the specific hydrogeological conditions encountered near the excavation. Such hydrogeological profiles are then used to design the groundwater control measures, such as cutoff walls, and well points and compute the groundwater inflows.

Soils at the VMF consist of medium dense existing fill over soft to stiff clay underlain by dense glacial till and weathered bedrock. We propose driven piles instead of drilled shafts to eliminate collection and disposal of contaminated soils. Groups of 10-inch square prestressed precast concrete piles are anticipated to provide the capacity required to support the building columns. Concrete piles are generally preferred over steel piles in a corrosive soil condition such as those encountered at the site. Based on the available borings, the dense glacial till is about 30 to 35 feet below grade, at which depth the piles are expected to terminate. If later the additional proposed soil borings at the site suggest the dense glacial till or bedrock depth is shallow, we will consider other alternatives such as micropiles, which could be drilled into the glacial till and bedrock to develop the required capacity.

The viaduct structures typically have high load demands in vertical and horizontal directions. As a result, drilled shafts are usually the preferred foundation type to limit the overall foundation footprint. We have proposed drilled shafts socketed into bedrock to support the viaducts. At Lechmere Branch, many shafts are 100 feet deep due to the relatively deep bedrock. Once we have a better understanding of the structural loads during the final design phase, we will explore other deep foundation options such as driven piles.

The existing three-span Washington Street bridge will be replaced with a single span bridge. With the significant load demand, we propose 7-foot-diameter drilled shafts with 6.5-foot-diameter, 15-foot-long rock sockets to support both abutments. For the bridges at Broadway and Medford Street, the abutments will be supported by 3.5-foot-diameter drilled shafts with 3-foot-diameter, 10-foot-long rock sockets. The bedrock surface is typically about 30 to 40 feet below grade at the these bridge locations, based on the boring logs. At the Medford Street bridge, the spread footing of the existing south abutment will be enlarged and strengthened with micropiles. This is due to the additional loads of the new span to accommodate the underpass behind the bridge. The micropile is anticipated to be 9.625 inches in diameter with 8.5-inch-diameter, 10-foot-long rock sockets.

Based on the anticipated loads and encountered soil conditions, spread footings are proposed at all stations except at Lechmere Station, which is to be elevated on the viaduct. The soils at Lechmere Station consist of medium dense existing fill over very soft organic soils and soft to stiff clays underlain by dense glacial till and weathered bedrock. We proposed 12-inch-diameter steel pipe piles at this preliminary design stage. Anticipated pile lengths range between approximately 80 to 115 feet at the north headhouse and between approximately 45 to 60 feet at the south headhouse. We anticipate the piles will stop in the very dense glacial tills or at the weathered bedrock. We will perform a pile drivability study at the final design phase, particularly when penetrating a thick glacial deposit. We will also explore other deep foundation options such as precast concrete piles.

Geotechnical and Hydrogeological Design Properties

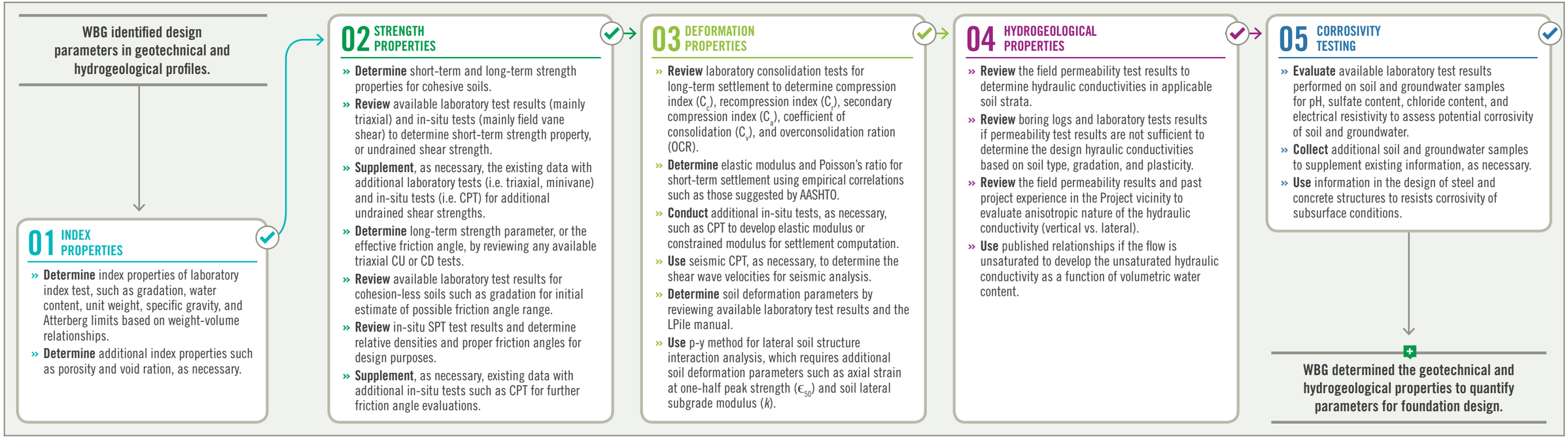
After identifying the necessary design parameters in the geotechnical and hydrogeological profiles, WBG will quantify those parameters for foundation design. We will use existing and future subsurface exploration data to determine the geotechnical and hydrogeological properties shown in Figure 4.2-7.

In addition to these design parameters, we will determine other soil properties as needed for particular design cases. Those parameters may include in-situ lateral stress ratio, soil sensitivities, residual friction angle, etc. For rock properties, laboratory test results on rock cores will be used to determine the index, strength, and deformation properties.

Additional Geotechnical Investigations, Testing, and Analysis

Numerous soil borings for the proposed structures have been drilled at the project site. However, project scope has been modified since the subsurface explorations and some changes, such as structure location, and size have been made to the proposed

Figure 4.2-7 Steps to develop geotechnical and hydrological design properties and parameters.


WBG identified design parameters in geotechnical and hydrogeological profiles.
01 INDEX PROPERTIES
» Determine index properties of laboratory index test, such as gradation, water content, unit weight, specific gravity, and Atterberg limits based on weight-volume relationships.
» Determine additional index properties such as porosity and void ration, as necessary.
02 STRENGTH PROPERTIES
» Determine short-term and long-term strength properties for cohesive soils.
» Review available laboratory test results (mainly triaxial) and in-situ tests (mainly field vane shear) to determine short-term strength property, or undrained shear strength.
» Supplement, as necessary, the existing data with additional laboratory tests (i.e. triaxial, minivane) and in-situ tests (i.e. CPT) for additional undrained shear strengths.
» Determine long-term strength parameter, or the effective friction angle, by reviewing any available triaxial CU or CD tests.
» Review available laboratory test results for cohesion-less soils such as gradation for initial estimate of possible friction angle range.
» Review in-situ SPT test results and determine relative densities and proper friction angles for design purposes.
» Supplement, as necessary, existing data with additional in-situ tests such as CPT for further friction angle evaluations.
03 DEFORMATION PROPERTIES
» Review laboratory consolidation tests for long-term settlement to determine compression index (C_c), recompression index (C_r), secondary compression index (C_α), coefficient of consolidation (C_v), and overconsolidation ration (OCR).
» Determine elastic modulus and Poisson's ratio for short-term settlement using empirical correlations such as those suggested by AASHTO.
» Conduct additional in-situ tests, as necessary, such as CPT to develop elastic modulus or constrained modulus for settlement computation.
» Use seismic CPT, as necessary, to determine the shear wave velocities for seismic analysis.
» Determine soil deformation parameters by reviewing available laboratory test results and the LPile manual.
» Use p-y method for lateral soil structure interaction analysis, which requires additional soil deformation parameters such as axial strain at one-half peak strength (ϵ_{50}) and soil lateral subgrade modulus (k).
04 HYDROGEOLOGICAL PROPERTIES
» Review the field permeability test results to determine hydraulic conductivities in applicable soil strata.
» Review boring logs and laboratory tests results if permeability test results are not sufficient to determine the design hyraulic conductivities based on soil type, gradation, and plasticity.
» Review the field permeability results and past project experience in the Project vicinity to evaluate anisotropic nature of the hydraulic conductivity (vertical vs. lateral).
» Use published relationships if the flow is unsaturated to develop the unsaturated hydraulic conductivity as a function of volumetric water content.
05 CORROSIVITY TESTING
» Evaluate available laboratory test results performed on soil and groundwater samples for pH, sulfate content, chloride content, and electrical resistivity to assess potential corrosivity of soil and groundwater.
» Collect additional soil and groundwater samples to supplement existing information, as necessary.
» Use information in the design of steel and concrete structures to resists corrosivity of subsurface conditions.
WBG determined the geotechnical and hydrogeological properties to quantify parameters for foundation design.

structures. We will review the completeness of the existing boring data against the proposed structure locations and possible foundation types. The existing in-situ and laboratory test results do not address all necessary soil design parameters; we anticipate that approximately 50 additional are needed to sufficiently define the soil design parameters for relevant analyses during final design phase. Figure 4.2-8 describes the steps WBG will take to identify additional soil borings and tests at locations where subsurface conditions are missing or insufficient (i.e., boring depths not adequate).

Preliminary Hydrogeological Impact Assessment and Risk Assessment

Construction Period

Groundwater Control: The GLX Project footprint has a relatively high water table. In order to ensure a quality subgrade in our construction excavations, WBG will create a Groundwater Management Plan (GMP) to establish the criteria for our soil groundwater control systems. As part of our GMP, we will procure and follow the necessary discharge and disposal permits from local, state, and federal government entities.

We anticipate using a combination of sump pits, collector drains, wells, well points, flow control devices, pumps, and piping to control the water in our subsurface excavations. These excavations include substructure footings, storm sewer and drainage trenches, utility trenches, and drilled shafts. In order to meet water quality requirements prior to discharge, we expect to use settlement tanks that will separate solids and oil from the pumped inflow. The water in the tanks may be treated before discharge.

Our GMP will address our approach to the treatment and disposal of contaminated water. The Reference Information Documents for the RFP show potential for contaminated water near Tufts Street, Ball Square Station, Broadway, and Water Street. Other contaminated soil areas within the right-of-way of the project may also contain contaminated water. We anticipate testing the groundwater for contamination, and those liquids containing oil and hazardous materials will be containerized, hauled off by a licensed hazardous waste hauler, and properly disposed according to the requirements of the 2017 Remediation General Permit. In conjunction with our GMP, we will create a Health and Safety Plan that protects the workforce, the public, and the environment when handling and disposing the contaminated liquids.

Support of excavation will be used to protect railroads, structures, utilities, and other facilities where groundwater intrusion may affect slope stability, ground loss, or settlement. Sheet pile or soldier beam and lagging will be used for cutoff walls. In addition to supporting the existing facilities, these walls will help exclude groundwater from entering the excavation and minimize the exposure to migration and disposal of contaminated groundwater. We will minimize the size and duration of our excavations and grade the slopes around excavations to minimize the inflow of surface runoff.

Groundwater Drawdown: The anticipated inflows depend on the geotechnical and hydrogeological profiles at the excavation locations, the hydraulic conductivities of the soils, the type of excavation support system used, and the groundwater conditions near the excavations. Given the subsurface conditions indicated in the borings, the majority of the site consists of granular materials such that the inflow will not be negligible. The flow rate and quantities of the inflow will be analyzed by performing 2D seepage analysis (i.e., axisymmetric) with appropriate hydraulic boundary conditions. Most excavations will require essentially "dry" working conditions for construction purposes. As a result, dewatering design usually coupled with cutoff walls is required to lower the groundwater table to about 2 to 3 feet below the excavation bottom.

We will evaluate the dewatering drawdown effect at the boundary conditions in seepage analysis. Since the subsurface strata may be complex, we will use finite element methods to define the geometries in terms of elements and nodal points. We will then use Darcy's law to correlate the total head and flow rate on the geometric domain to calculate the flow paths, equipotential lines, and the inflow quantities.

Figure 4.2-6 shows an example of a seepage analysis at an excavation location, where a cutoff wall is assumed on the perimeter of the excavation extending into the clay layer. Groundwater control measures (e.g., dewatering wells inside the excavation support system) are assumed to be in operation continuously so that it represents a steady-state seepage condition. With appropriate boundary conditions, the seepage analysis will compute the anticipated inflows into the excavation to be pumped. The dewatering system will be designed based on the anticipated quantity of inflows using Dupuit-Thiem method.

We will design the dewatering system with minimal groundwater drawdown outside of the excavation zone. If our dewatering design identifies structures that will be located within the groundwater drawdown zone, we will perform a settlement assessment prior to actual dewatering operations. We will use conventional settlement analysis methods (i.e., consolidation theory) to estimate the settlement based on the anticipated groundwater drawdown.

Permanent Condition

The groundwater control strategy will be based on either dewatering techniques or cutoff wall techniques, or a combination of both. When the excavation is to accommodate permanent structures, such as retaining walls or hoist pit, it is critical to design those structures with proper hydrogeological conditions. If the structure will be designed undrained, no groundwater control is to be provided. Correspondingly, the structure has to be designed to withstand the hydrostatic pressures, considering the possible groundwater fluctuations. The hydrostatic condition similar to pre-construction may be assumed and no groundwater inflow is anticipated in permanent condition. For instance, the hoist pit of the VMB may need to be designed for full buoyancy. The waterproofing system of the undrained structure will require a layer of waterproof materials to prevent water infiltration into the structure.

Figure 4.2-8 Geotechnical investigation and analysis steps.

01 IDENTIFY DATA GAPS & PROPOSE NEW BORINGS

- **Drill** borings not previously obtained due to the presence of existing structures.
- **Coordinate** in a timely manner those borings not previously obtained due to access issues.
- **Verify** existing and proposed boring locations using the most current proposed structure locations.

The following documents were thoroughly reviewed by WBG staff to identify data gaps and boring locations:

- ✔ Final RFP Document, Volume 2: Section 15.1
- ✔ AREMA, MassDOT, AASHTO, FHWA, and IBC requirements
- ✔ Local building codes
- ✔ RIDs provided with RFP

02 DETERMINE BORING TERMINATION DEPTH

- **Consider** the proposed structure type, foundation type and size, and the projected influence zone of the foundations.
- **Identify** borings that shall extend below the deepest foundation base at least 10 feet and a minimum of three times the proposed footing width or three times the largest dimension of the proposed pile section.
- **Perform** rock coring where bedrock is within the influence zone to determine the bedrock depth and the rock properties.

03 IDENTIFY ANY ADDITIONAL IN-SITU TESTING

- **Identify** standard penetration test, permeability test, and vane shear test for existing in-situ test data.
- **Review** existing soil data and determine if any additional in-situ tests are necessary.
- **Review** the in-situ and laboratory test results and determine if sufficient test results are available at locations with thick clay deposits.
- **Consider** in-situ tests such as cone penetration testing (CPT) to characterize the continuous soil strength and deformation properties if sufficient test results are not available.
- **Perform** a seismic CPT for soil shear wave velocities for seismic foundation design and vibration analysis, as necessary.

04 DETERMINE ANY ADDITIONAL LABORATORY TESTING

- **Review** existing soil/rock sample laboratory test data which typically includes index property tests, strength tests, and deformation tests.
- **Review** soil design profiles at proposed structure locations.
- **Perform** necessary laboratory tests on samples that supplement the existing data to sufficiently define the soil profiles and associated design parameters for foundation stability and serviceability design.
- **Perform** additional testing to assess corrosivity of soil and groundwater, as necessary.

At this time, WBG anticipates approximately 40 additional explorations required to complete the design for the remaining portions of the Project.

If the structure is to be designed drained, groundwater controls will be needed to satisfy the drained condition. The waterproofing system will consist of either a footing drain (such as a perforated pipe surrounded by gravel or crushed stone or a sump pump, or a combination of both. Due to the permanent design of the system, we anticipate the waterproofing system is in continuous operation. A similar seepage analysis as described for the construction period will be used to estimate the anticipated groundwater inflow: the footing drain or the sump pump will be converted to appropriate hydraulic boundary conditions, and thus a steady-state groundwater flow is expected to occur. Similar to the construction period discussion, we will evaluate the possible ground settlement due to groundwater drawdown and implement mitigation measures as necessary to minimize the drawdown effect outside of the project structures. Figure 4.2-9 shows an example of waterproofing design for a perimeter foundation wall with a groundwater drawdown in the structure vicinity.

Preliminary Geotechnical Impact Assessment and Risk Assessment

The proposed construction corridors are located in densely populated urban areas with numerous buildings, utilities, and infrastructure nearby. The proposed foundation installation activities and methodologies, such as footing excavations, temporary retaining structures, use of heavy equipment for pile driving, and drilled shaft installations, must be performed using methods that will limit impacts to those structures or utilities. WBG will conduct a pre-construction condition survey to identify possible structures within the zone of influence, to determine the nature (i.e., historic, sensitive, etc.) of the structure, and to document the existing condition of the structures. We will develop an instrumentation and monitoring plan, accompanied by working drawings, as illustrated in Figure 4.2-10 to monitor groundwater levels, vibrations, vertical settlement, and lateral movement of temporary support structures and adjacent ground, existing utilities and structures during construction.

Based on our current design approach, and assessment of existing subsurface conditions, we anticipate that lateral and vertical deformations of temporary and permanent earth support structures will generally be limited to approximately 1 to 2 inches, and 0.5 to 1 inches, respectively. Where construction is located in close proximity to existing structures, the excavation support system and instrumentation monitoring program will be designed to limit impacts to those structures, as described in Figure 4.2-10.

Figure 4.2-9 Illustration of permanent waterproofing at a drained structure.

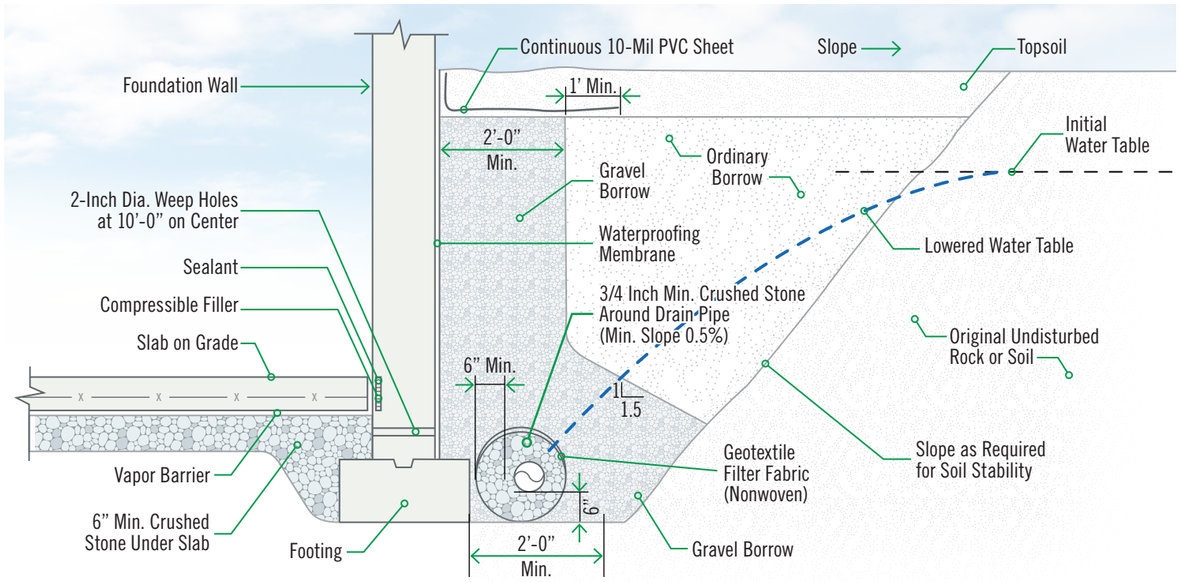


Figure 4.2-10 Preliminary geotechnical impact assessment and risk assessment plan.

01 MONITOR TEMPORARY SUPPORT STRUCTURES

- **Instrument and monitor** to verify design assumptions and ensure work safety.
- **Plan** locations of instrumentation around the perimeter of excavations so the overall change of pore pressures and configuration of support systems are monitored and recorded.
- **Read** each instrument before and after each stage of construction and once daily, at minimum.

Instrumentations include:

- ✔ Observation wells and/or vibrating wire piezometers: *power water pressures*
- ✔ Inclinometers: *lateral wall deflection and tilting*
- ✔ Deformation monitor points (DMPs): *lateral/vertical movements*

02 MONITOR ADJACENT GROUND, UTILITIES, AND STRUCTURES

- **Perform** site inspection, at least once per month prior to construction, to identify all ground/utilities/structures in the construction zone to be monitored.
- **Document** the initial conditions and determine the nature of all adjacent structures within the zone influence.
- **Plan and install** instrumentation on adjacent ground/utilities/structures within the influence zone.
- **Read** each instrument, at minimum, once daily if construction is within 140 feet of structure.
- **Conduct** inspections during construction to identify any visual adverse effects, particularly on vibration-sensitive structures.
- **Perform** final post-construction inspection of structure/utility conditions and document any differences.
- **Abandon** instrumentation in accordance with standard procedures.

Instrumentations include:

- ✔ DMPs: *vertical/lateral movements*
- ✔ Utility monitoring points: *utility movement*
- ✔ Tiltmeters: *tilting of structures*
- ✔ Inclinometers: *lateral wall deflection and tilting*
- ✔ Multi-point probe extensometers: *vertical ground deformations*
- ✔ Piezometers and observation wells: *ground-water levels*
- ✔ Seismographs: *ground vibrations and noise levels*

03 MITIGATION PLAN

- **Establish** a threshold value and limiting value for each instrument monitoring type depending on the structure/utility type, sensitivity to movement, applicable industrial guidance, and the owner's input.
- **Develop** a Response Action Plan that anticipates actions to implement on measured deformation/vibration levels.
- **Execute** the actions defined in the Response Action Plan, upon reaching measurements, to ensure limiting values are not met.
- **Evaluate** construction methods immediately if threshold values are apparent.
- **Change** construction method to manage and avoid adverse effects on adjacent structures/utilities.
- **Stop** work assumed to be contributing to excessive vibration/deformation in the area of concern if the measurement equals or exceeds limiting values.
- **Implement** mitigation actions to investigate and correct damage to adjacent structures/utilities (may include temporarily restoring site conditions such as excavation backfill for ground stabilization.)
- **Resume** work only after identifying operations that created or substantially contributed to excessive deformation/vibration values and we have revised or managed the construction method or equipment.

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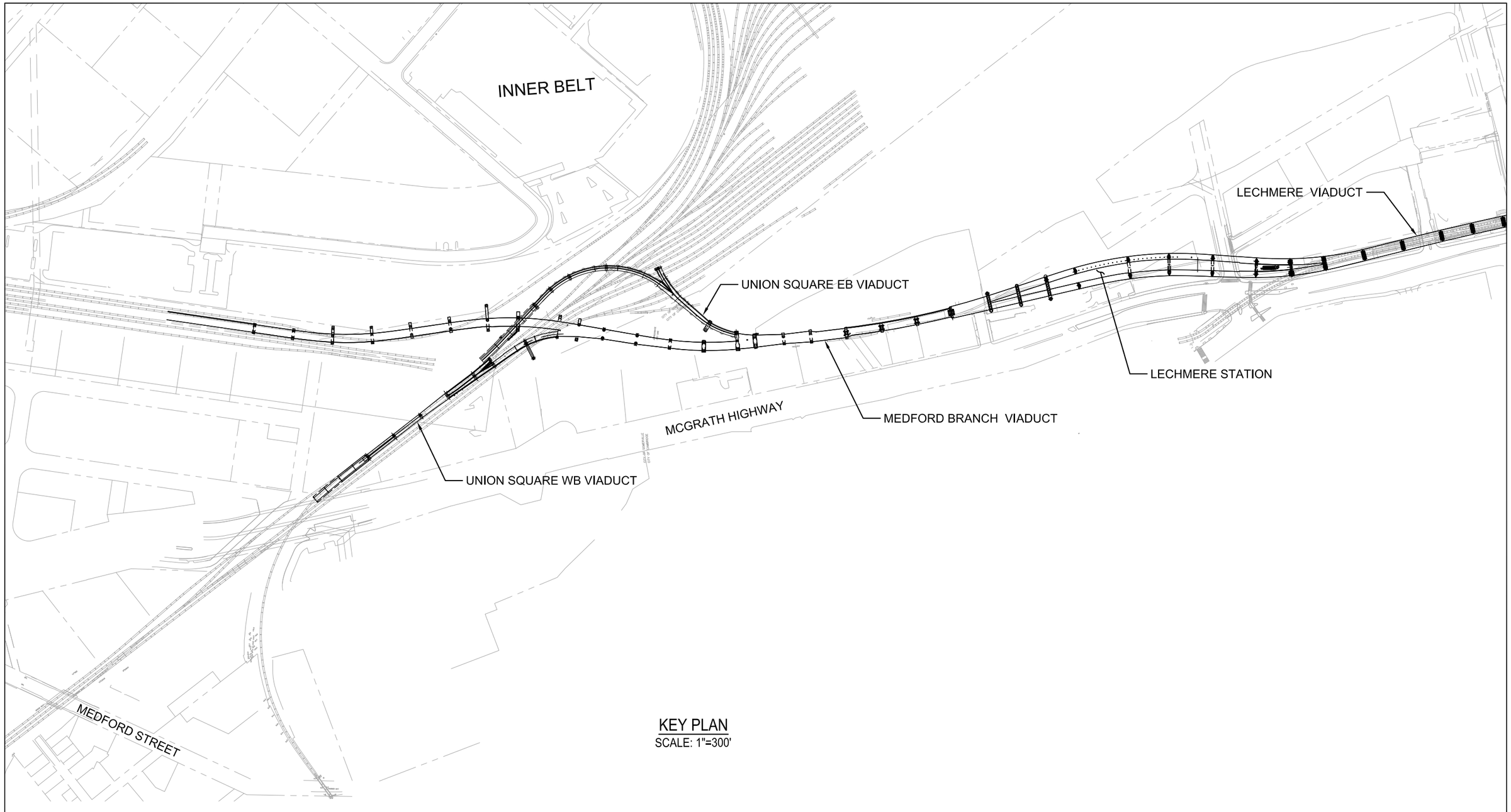


KEY PLAN
SCALE: 1"=300'

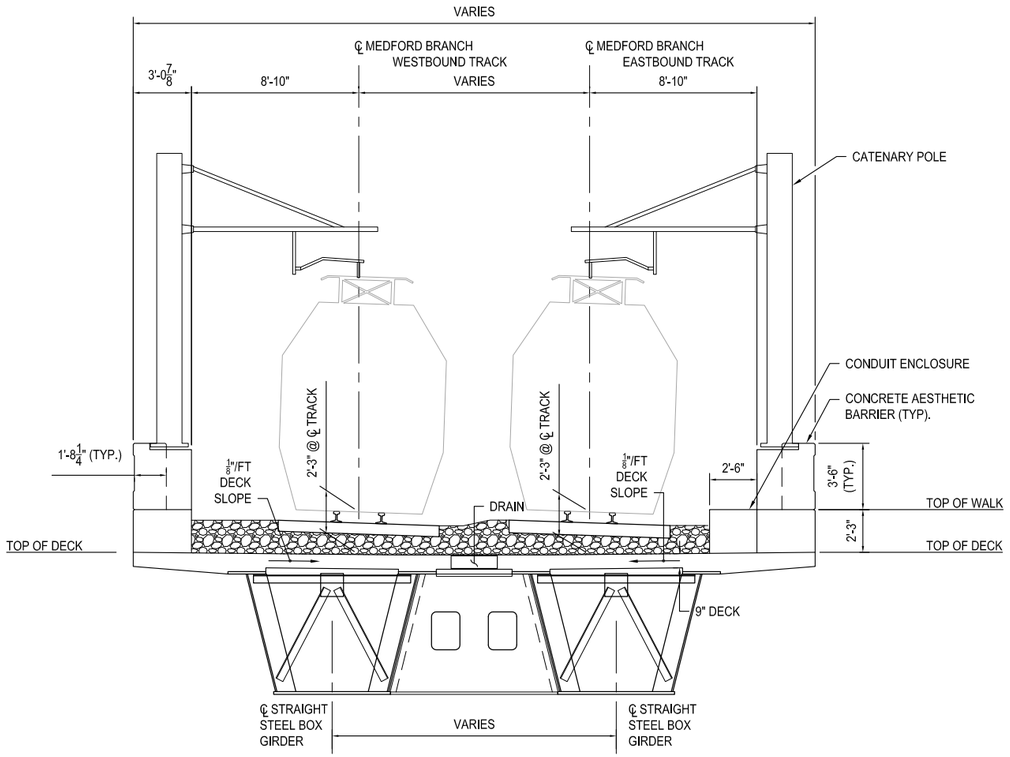
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

VIADUCTS: LECHMERE, MEDFORD, UNION SQUARE, AND YARD LEADS

DATE: SEPT. 28, 2017 | SCALE: 1"=300' | SHEET **000-S-0001**



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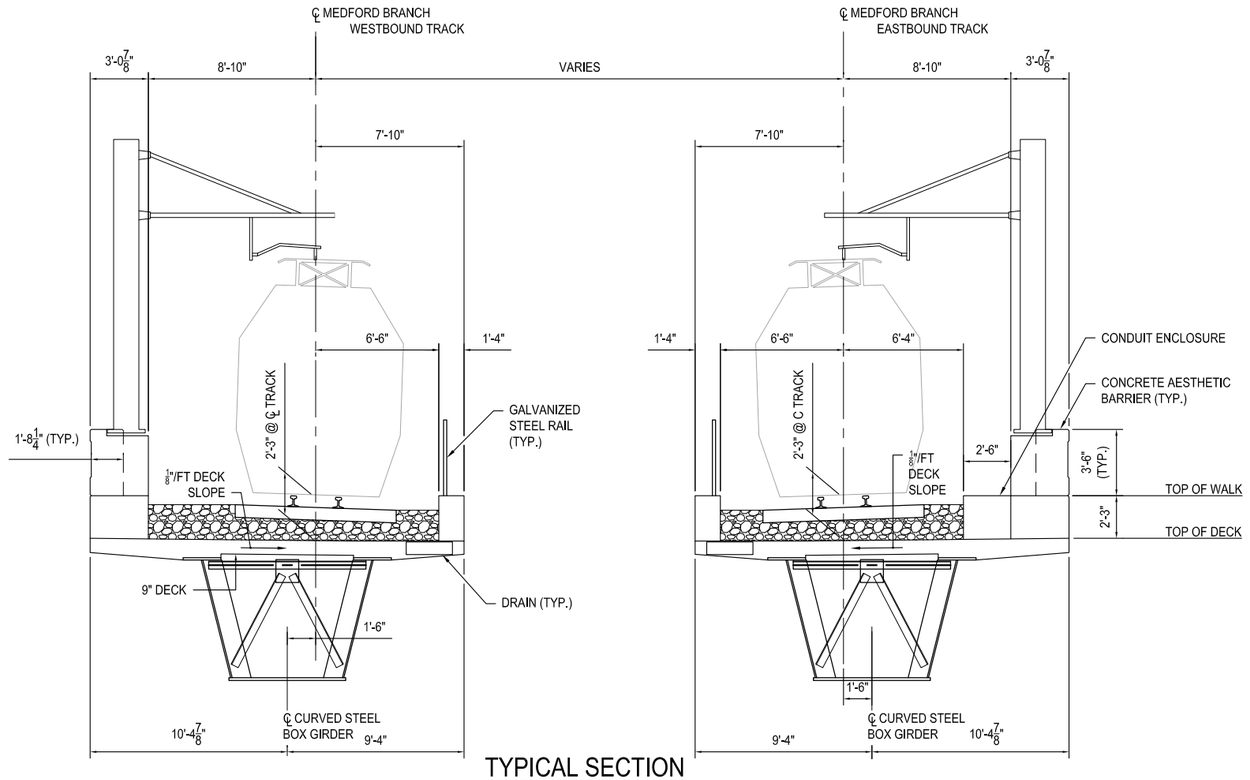

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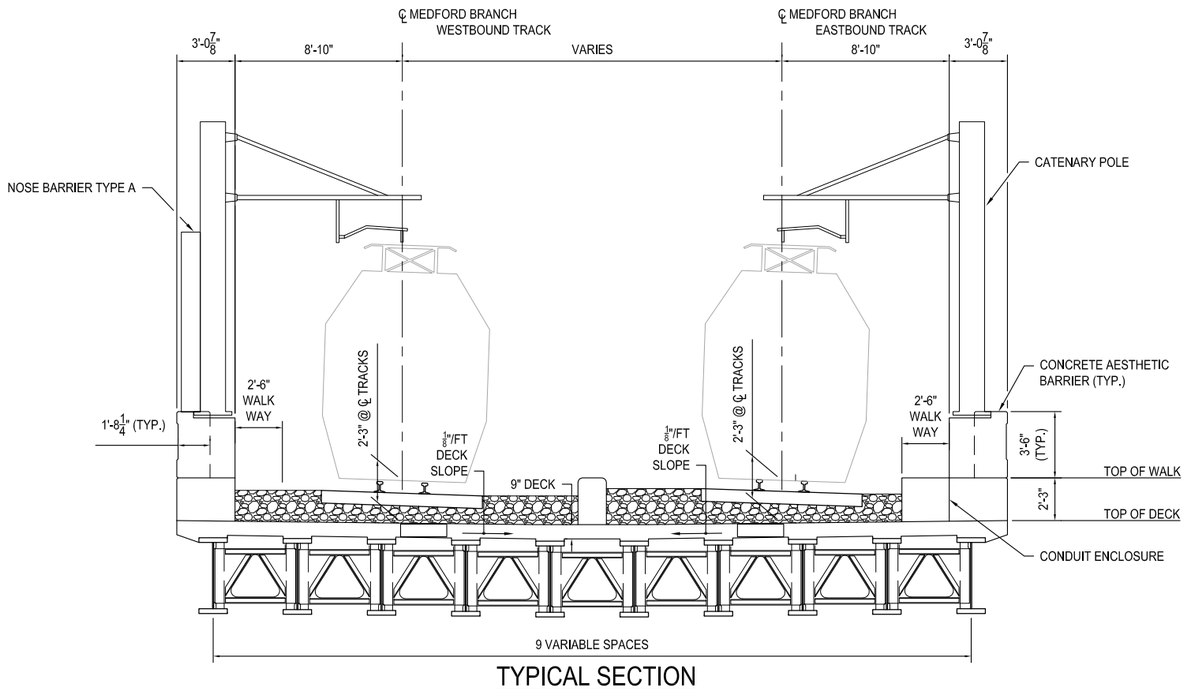

TYPICAL SECTION

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MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

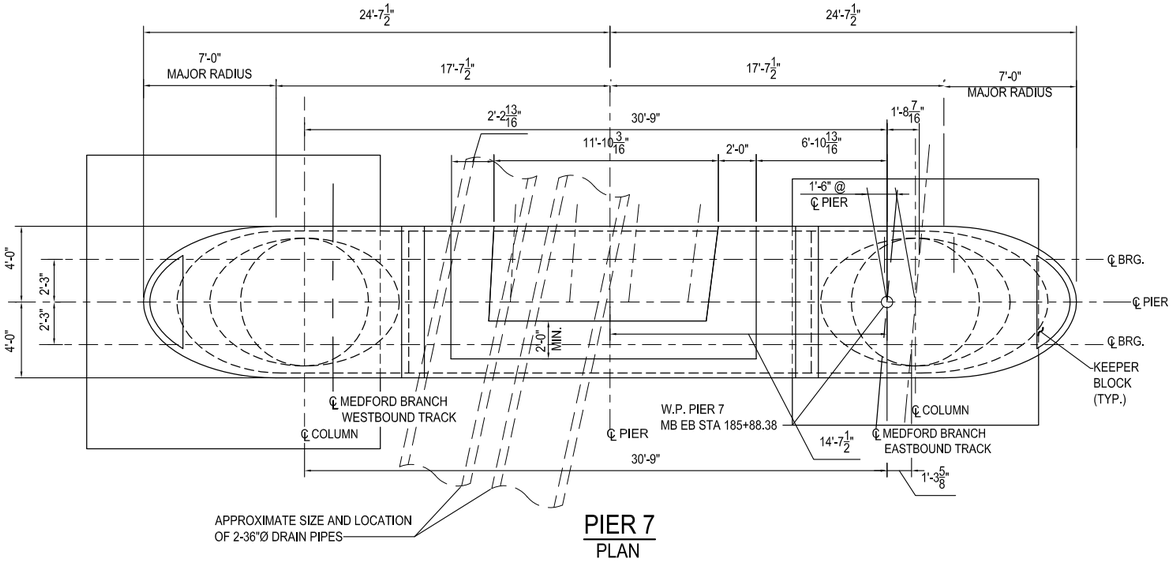
THE WALSH BARLETTA GRANITE

Joint Venture Team

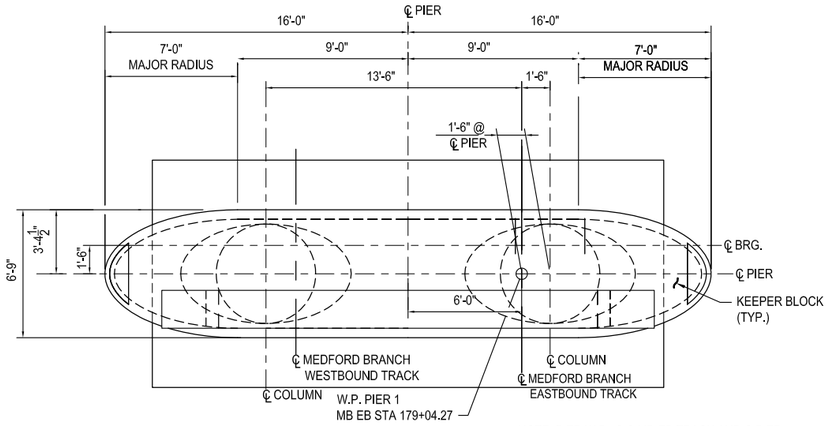
LECHMERE VIADUCT

TYPICAL SECTIONS

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET **LEV-S-8001**

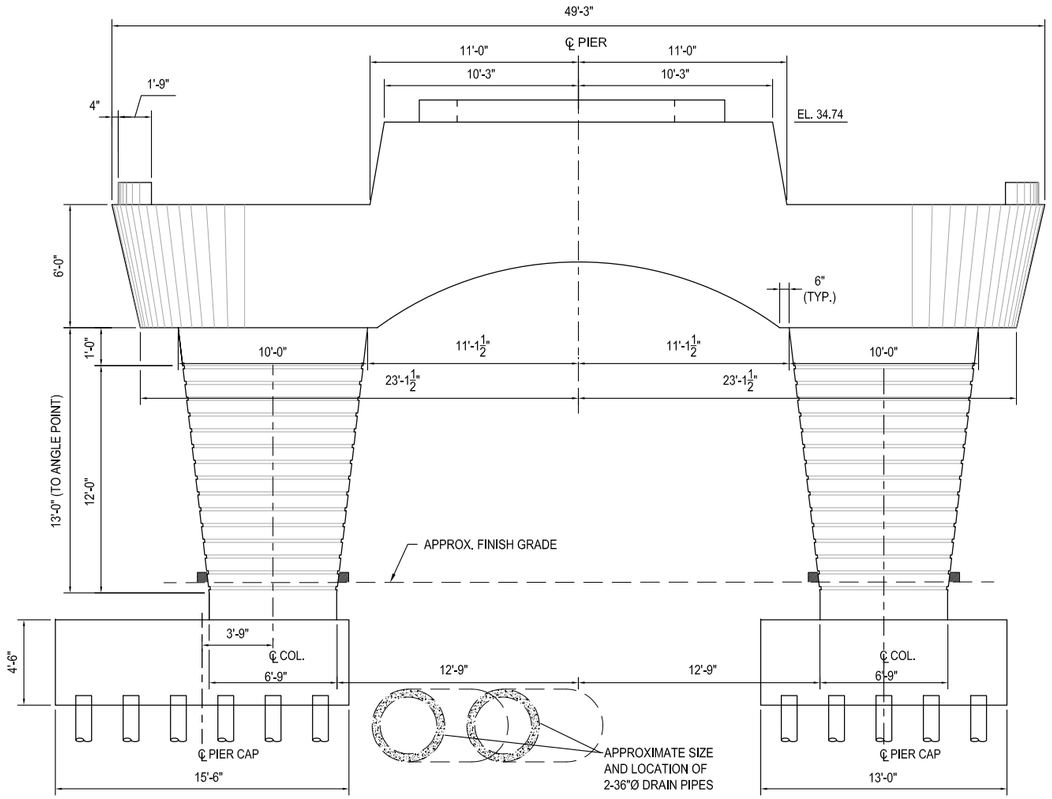


PIER 7
PLAN



NOTE: PIER W.P. IS ℄ MB-EB TRACK AND ℄ PIER

PIER 1
PLAN



PIER 7
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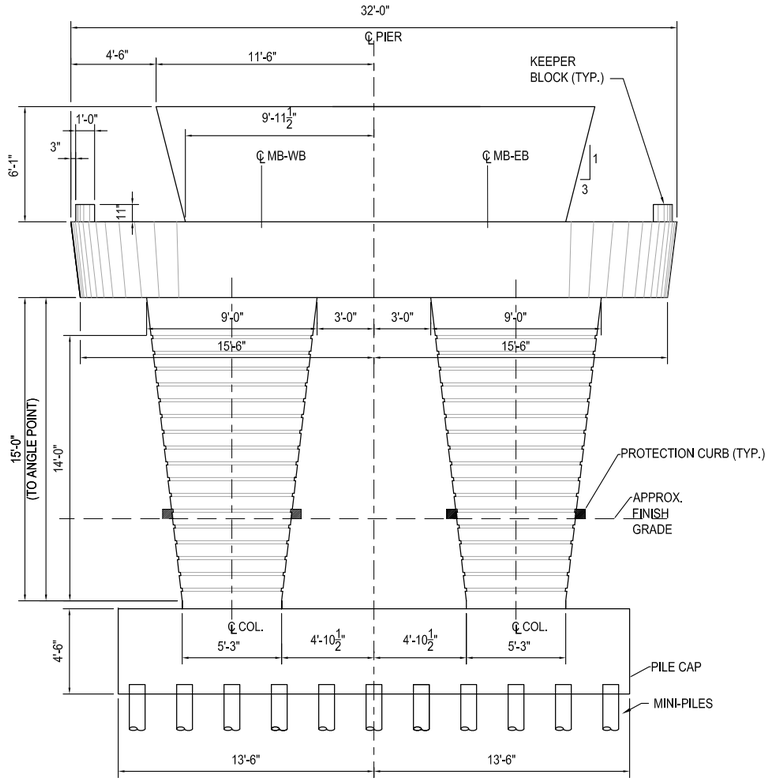

PIER 1
ELEVATION

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GREEN LINE EXTENSION PROJECT
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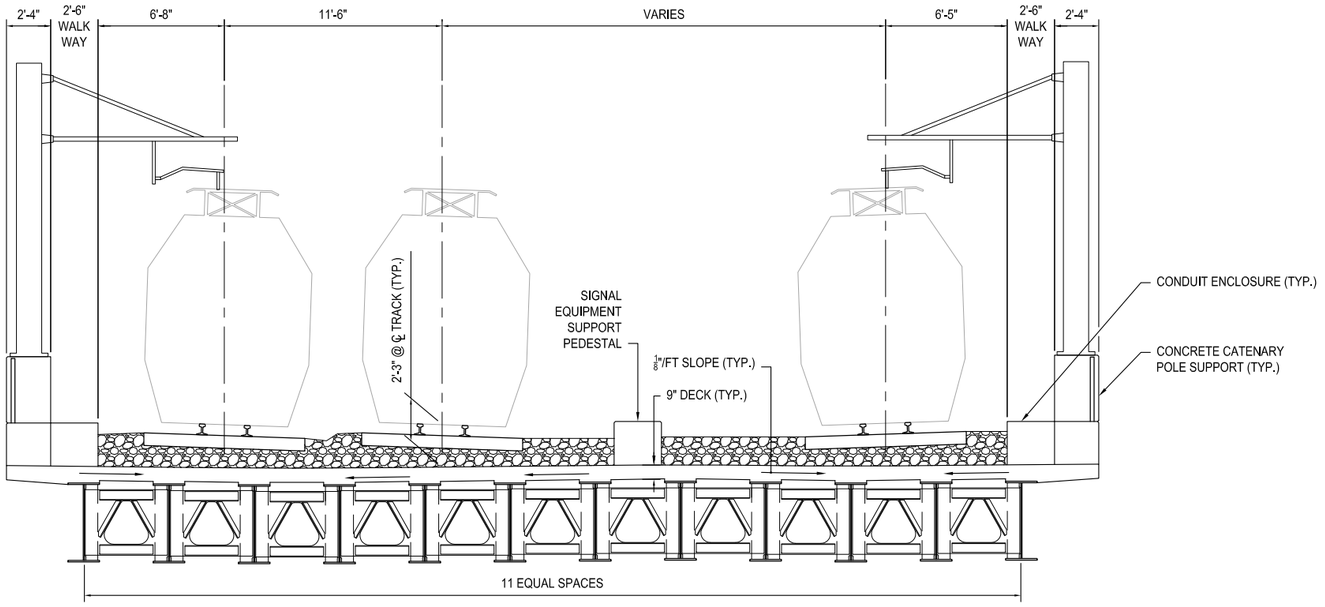
LECHMERE VIADUCT
TYPICAL PIERS

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET **LEV-S-8002**



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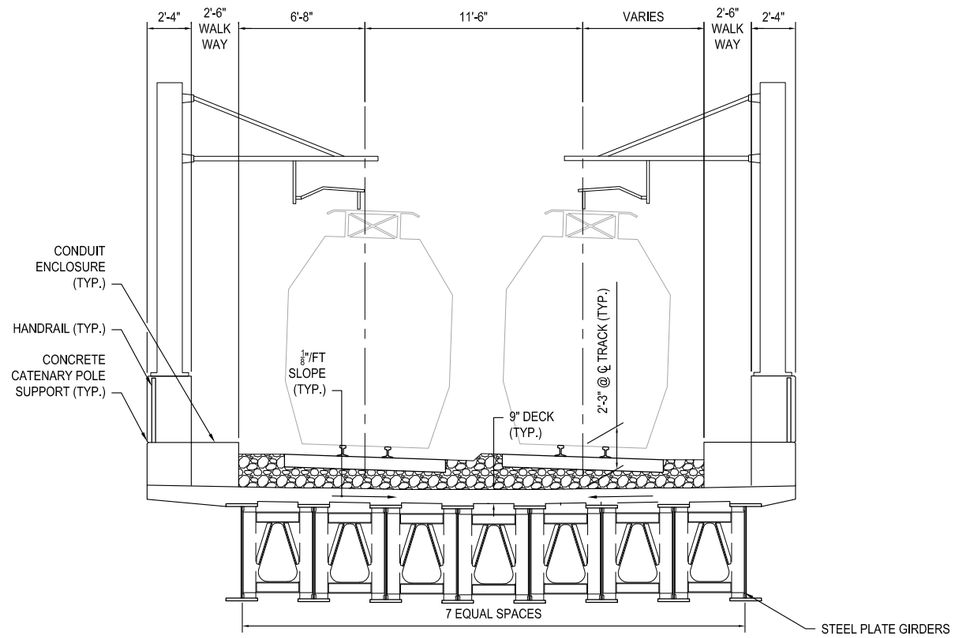

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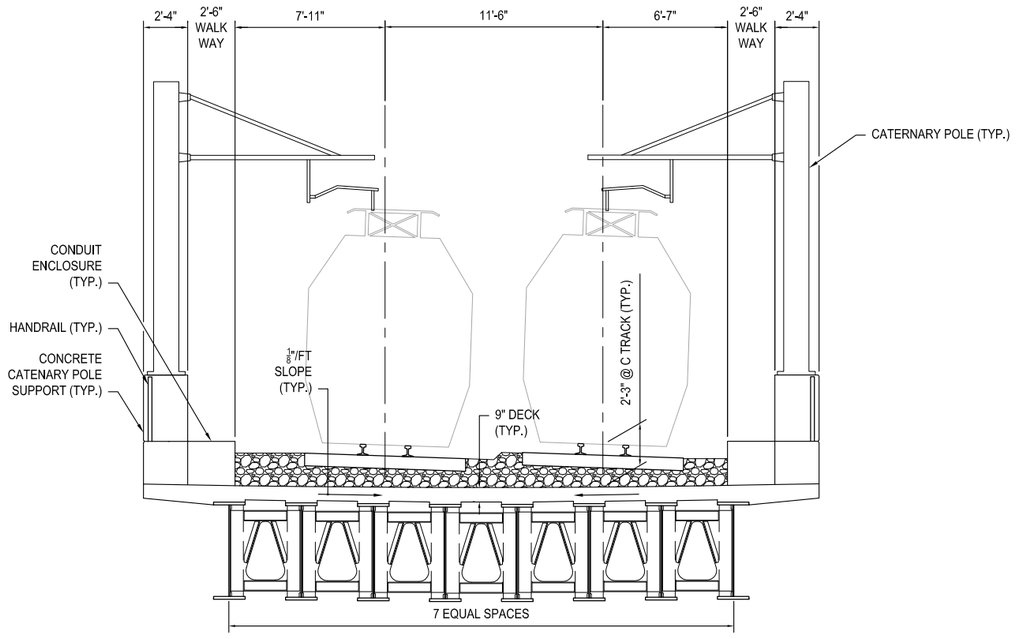

TYPICAL SECTION

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GREEN LINE EXTENSION PROJECT
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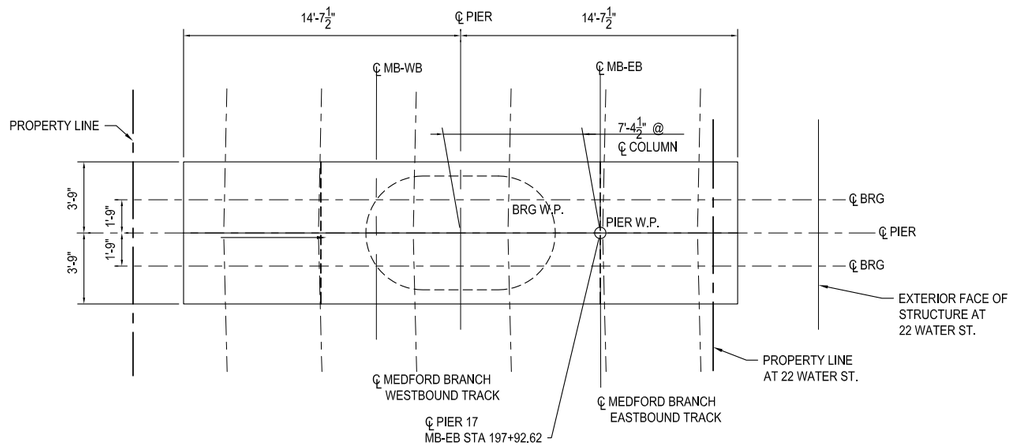
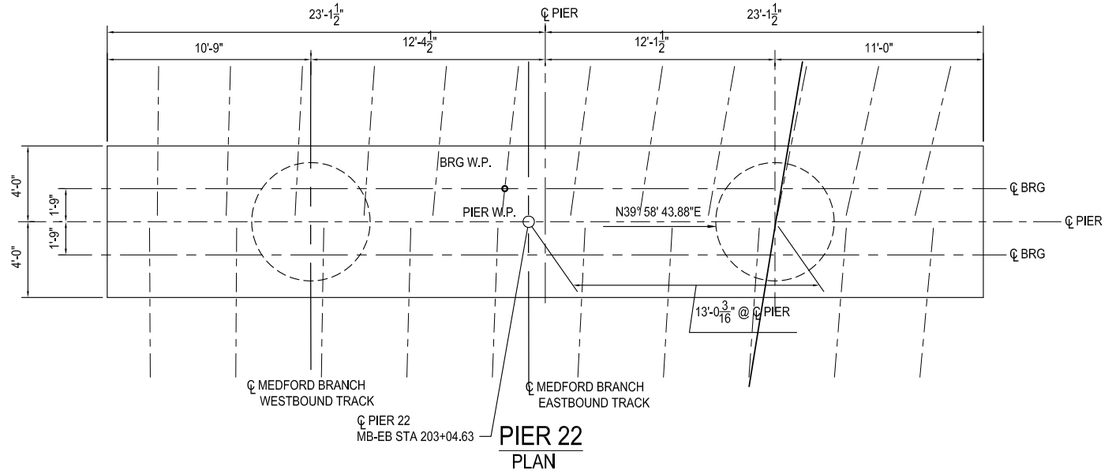
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH VIADUCT
TYPICAL SECTIONS

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET **MLV-S-8001**



PIER 17
PLAN



PIER 22
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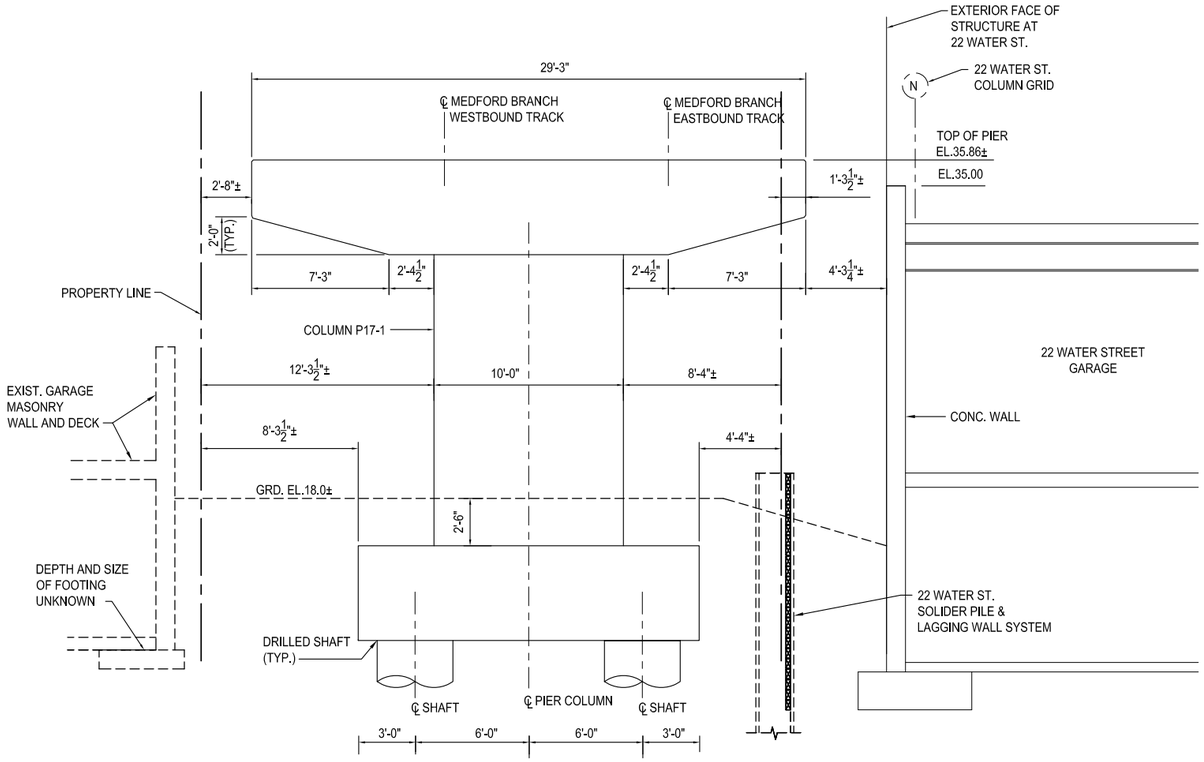

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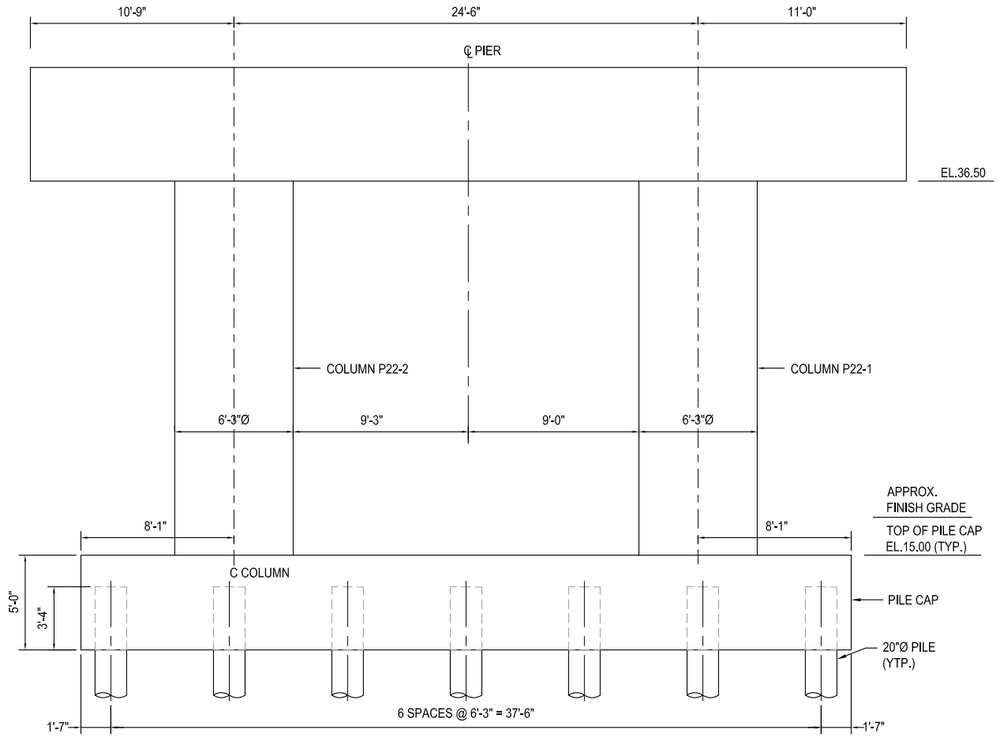

PIER 22
ELEVATION

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

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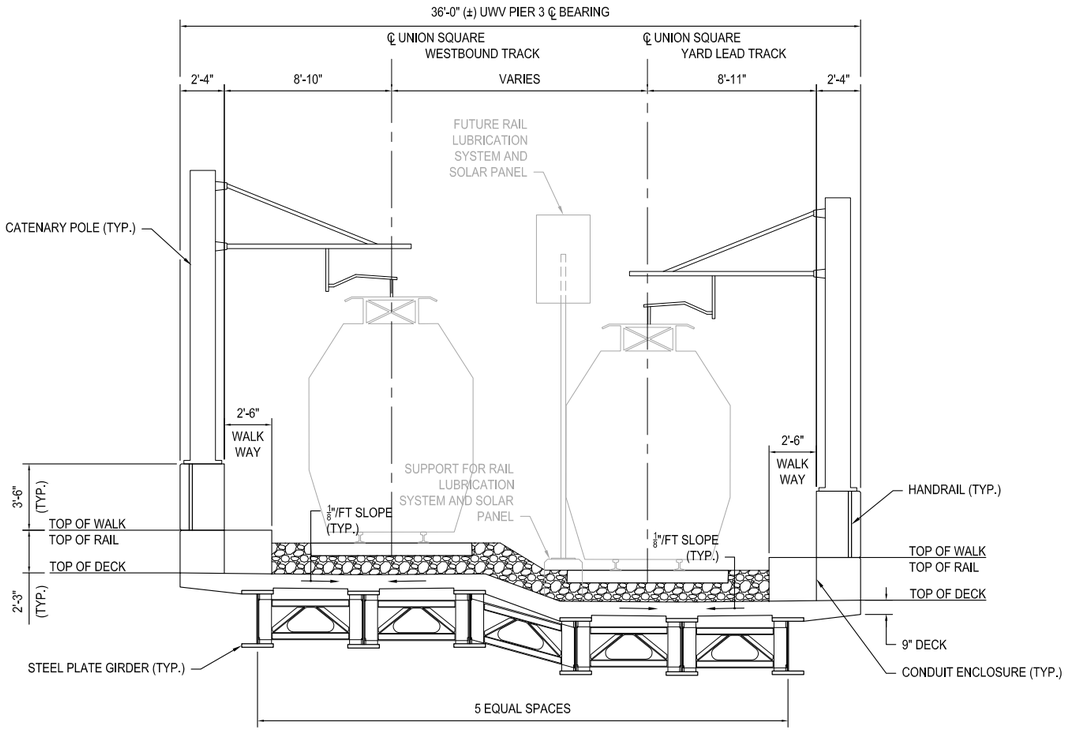
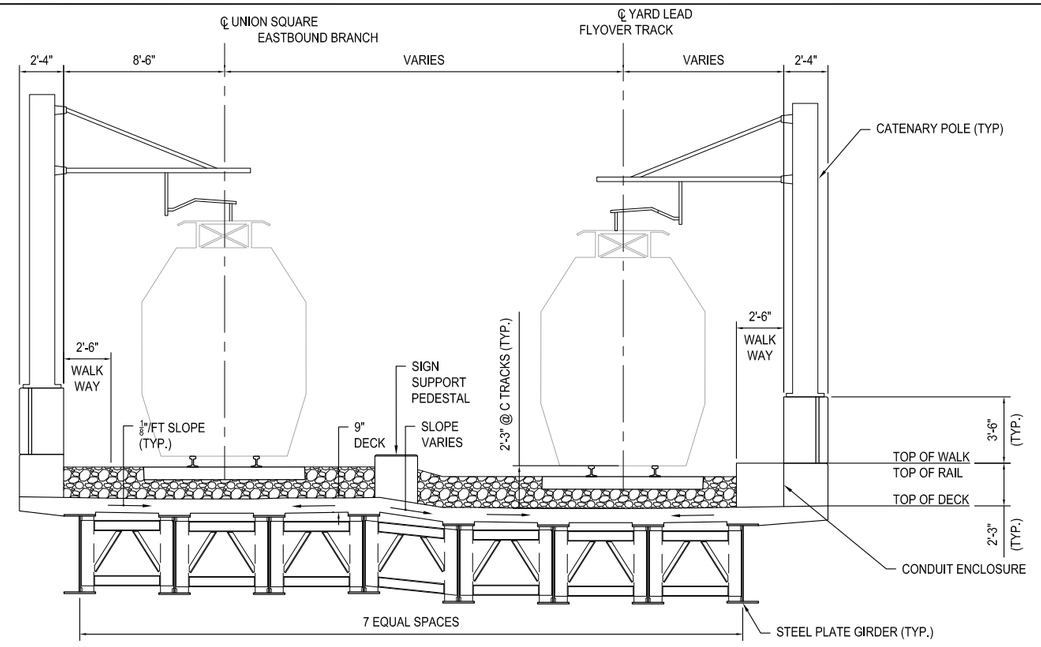
MEDFORD BRANCH VIADUCT
TYPICAL PIERS
PLAN AND ELEVATION

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET **MLV-S-8002**



FROM UWV STA. 4+44.96 TO 4+96.20

(SECTION FROM STA. 4+96.20 TO STA. 5+14.96 SIMILAR)



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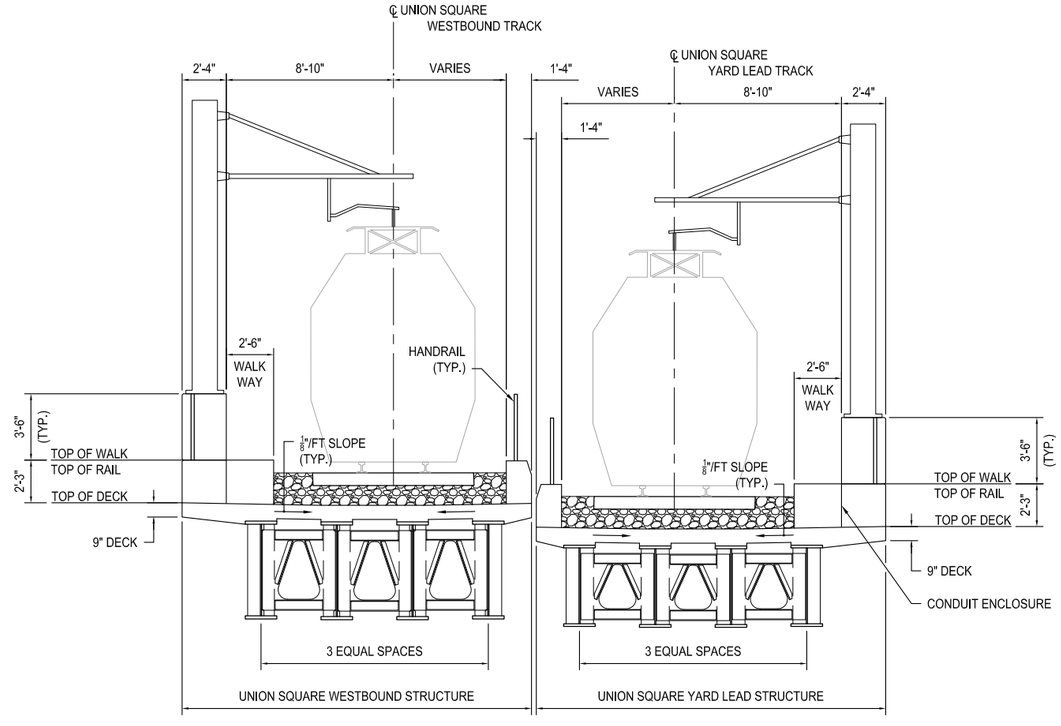

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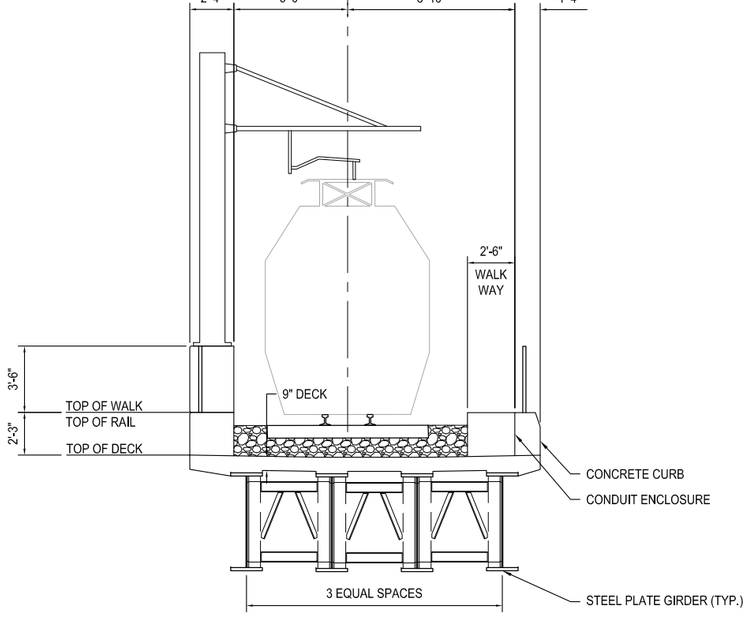

FROM STA. 1+57.23 TO 2+52.40

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE

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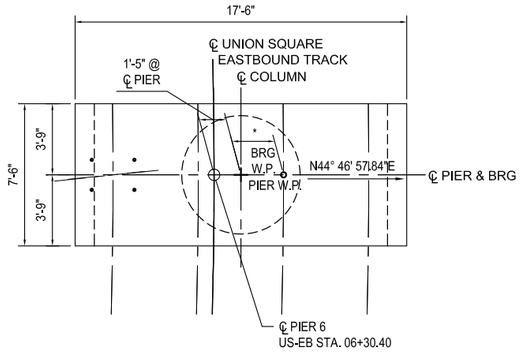
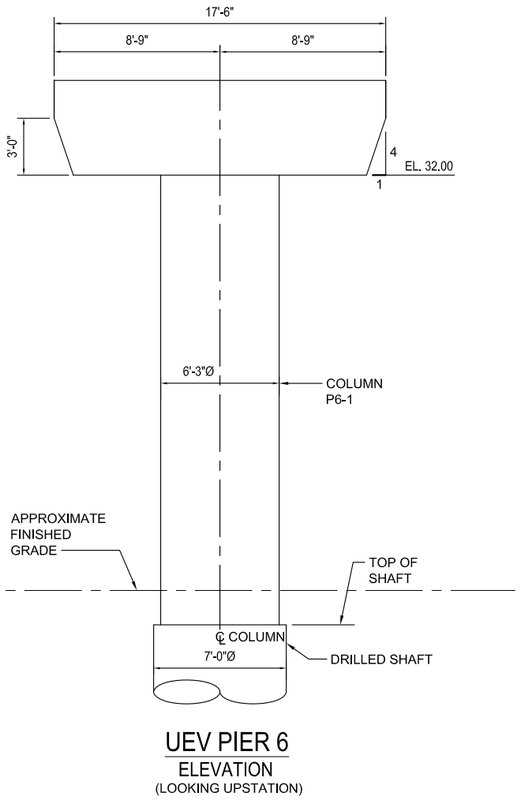
UNION SQUARE EASTBOUND AND WESTBOUND VIADUCTS TYPICAL SECTIONS

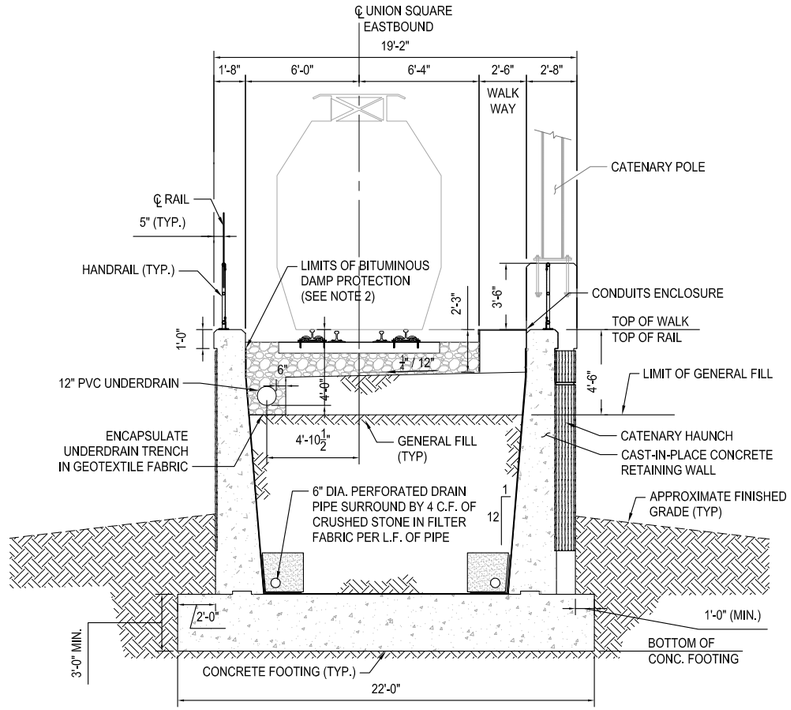
DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET **UWV-S-8001**



UEV PIER 6
PLAN



UEV PIER 6
ELEVATION
(LOOKING UPSTATION)



TYPICAL SECTION AT CATENARY POLE HAUNCH

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
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UNION SQUARE EASTBOUND AND WESTBOUND VIADUCTS
TYPICAL PIER AND APPROACH SECTION

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET **UEV-S-8001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
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VIADUCT RENDERING

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-S-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
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VIADUCT ISOMETRIC VIEW RENDERING

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **LEV-S-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
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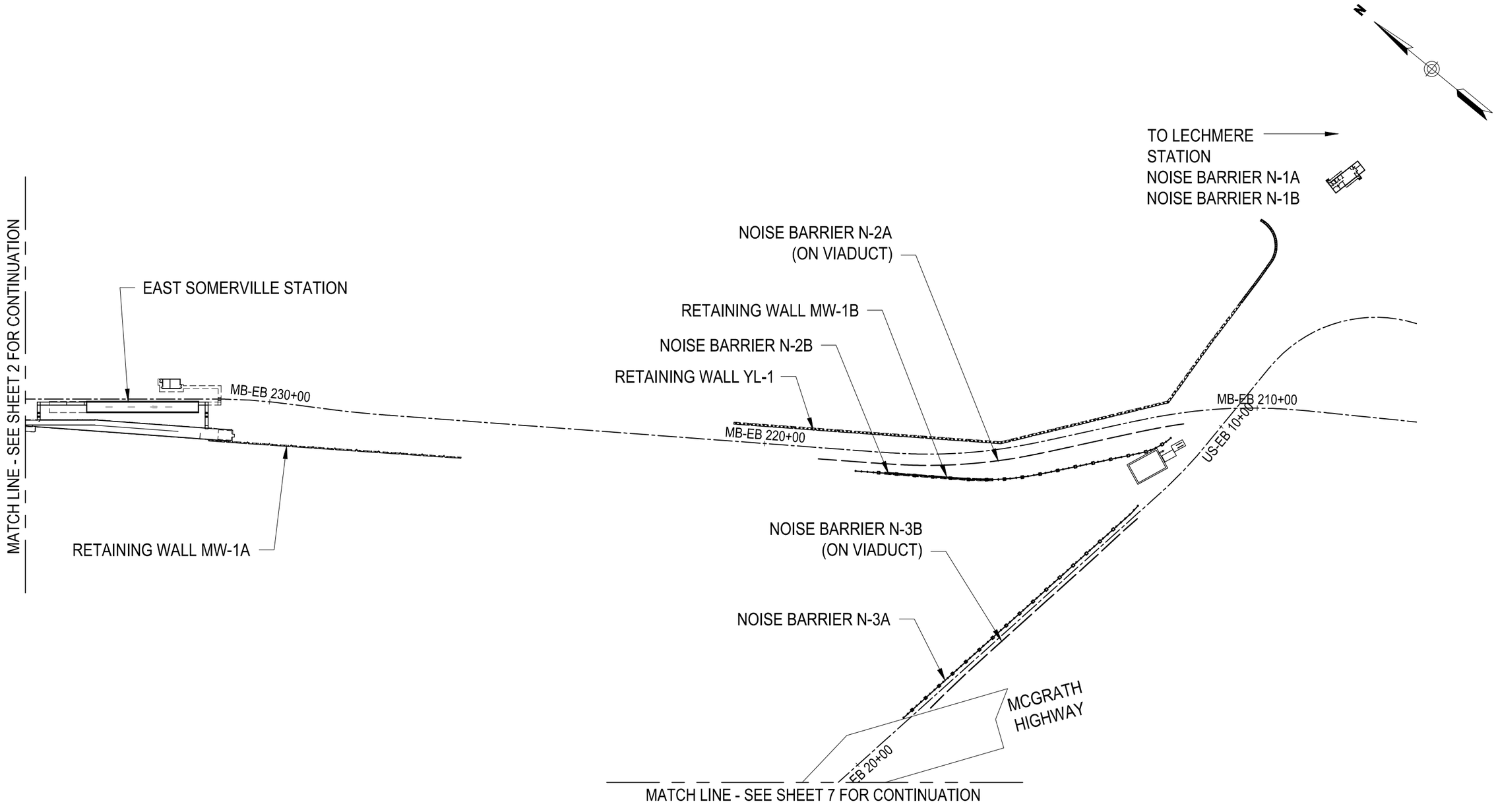
LECHMERE VIADUCT RENDERING
CONNECTION TO EXISTING PIER 13

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **LEV-S-0002**



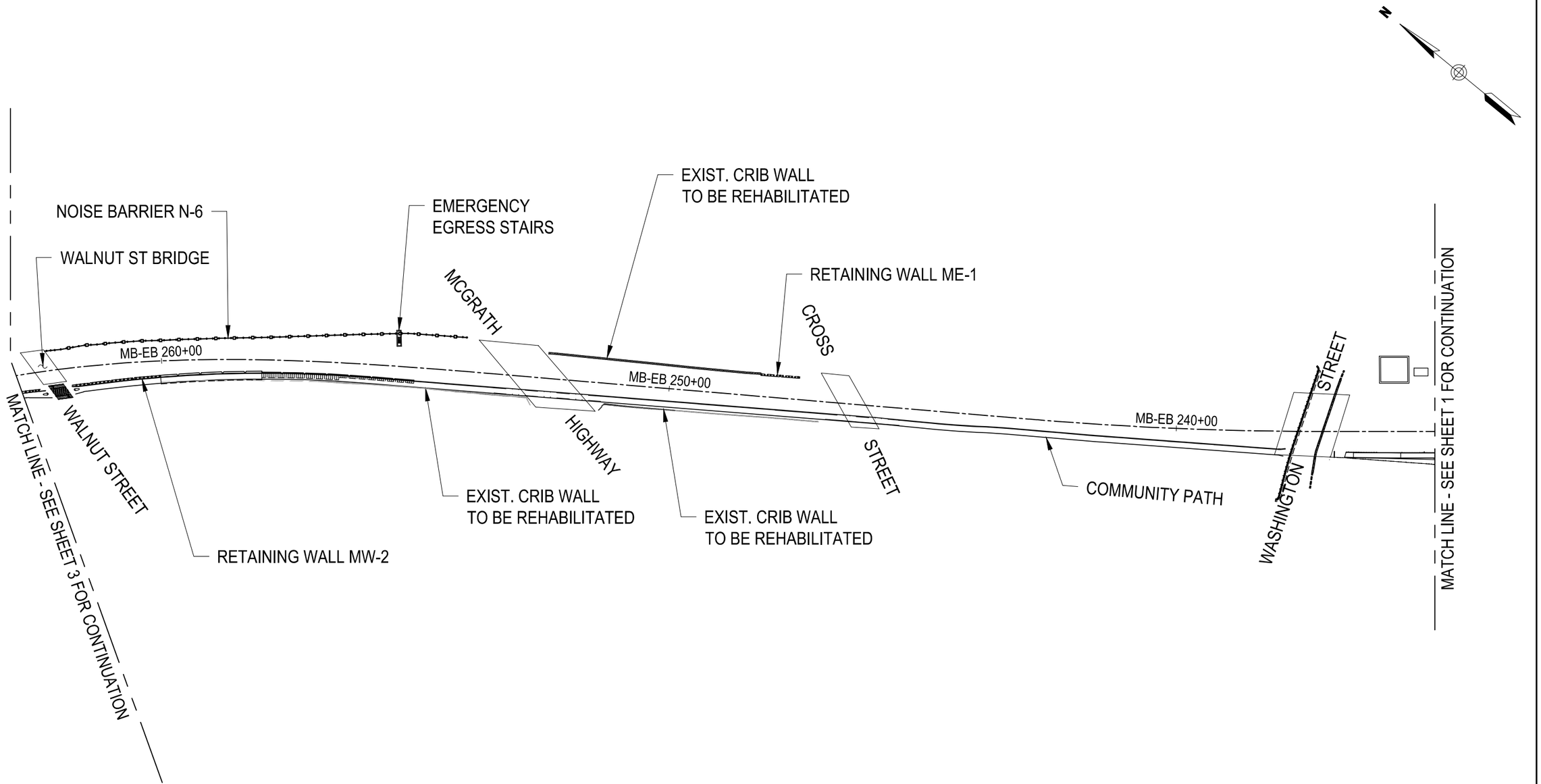
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD AND UNION BRANCH CORRIDOR WALL KEY PLAN SHEET 1

DATE: SEPT. 28, 2017 | SCALE: 1": 200□ | SHEET **RWS-S-1001**



SCALE IN FEET

0 100 200 300

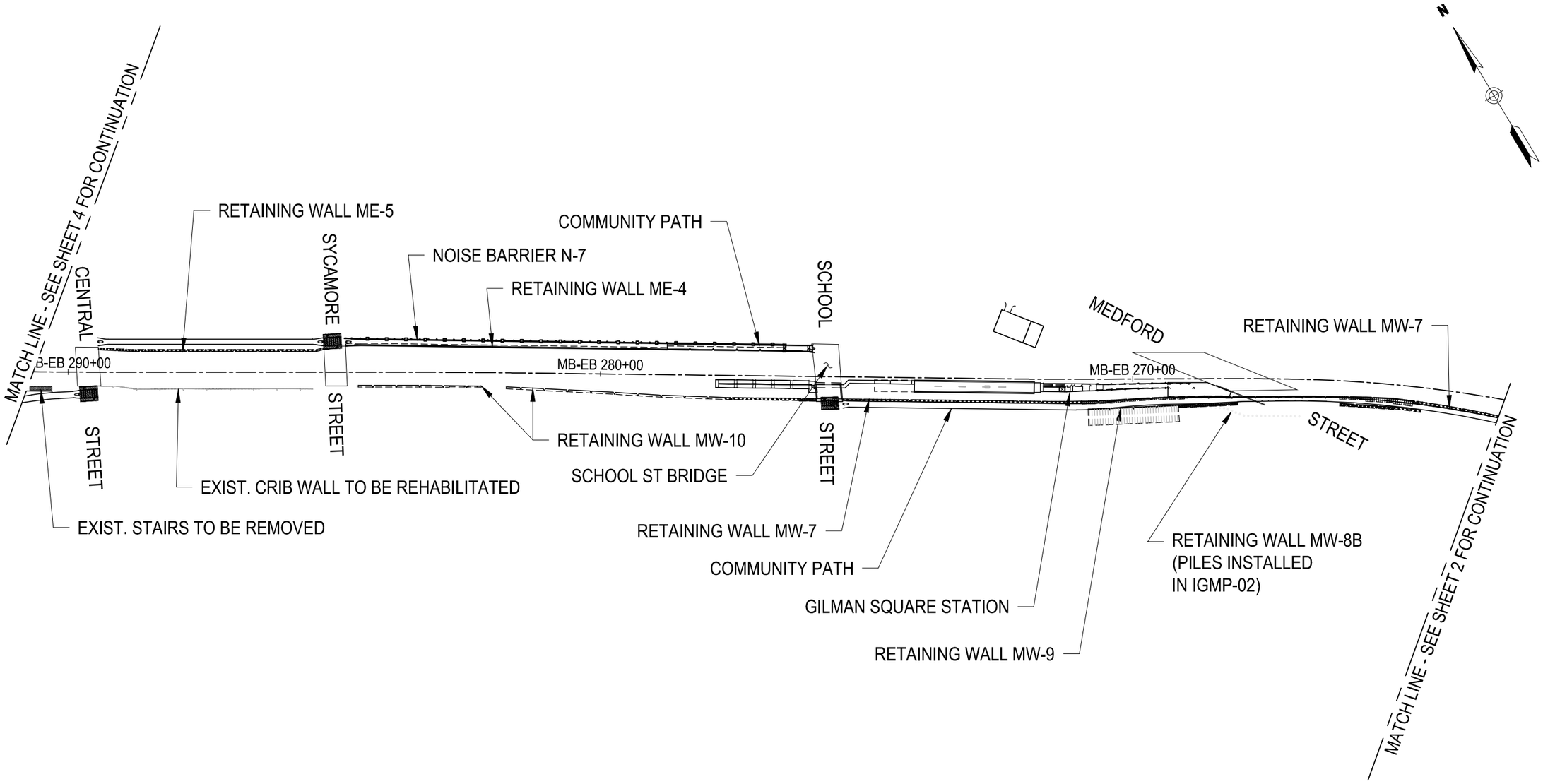
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD AND UNION BRANCH CORRIDOR WALL KEY PLAN SHEET 2

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: 1"=200' | SHEET **RWS-S-1002**



SCALE IN FEET

0 100 200 300

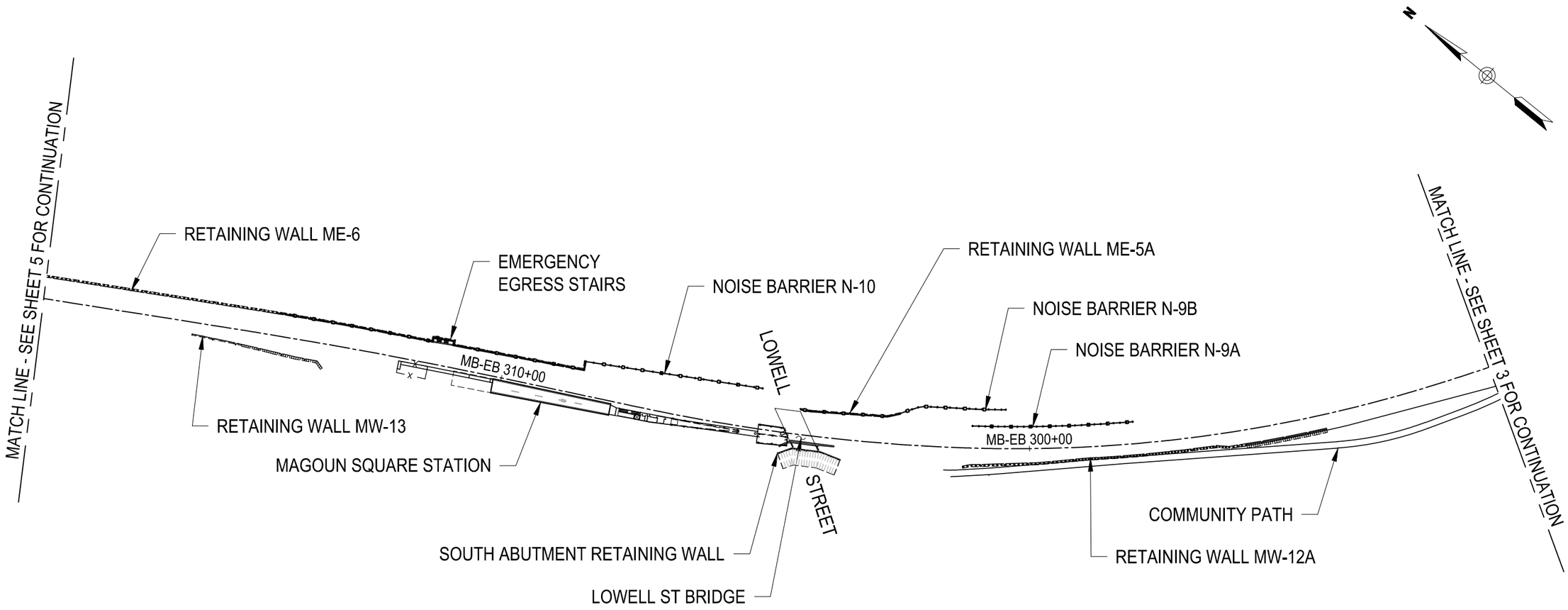
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD AND UNION BRANCH CORRIDOR WALL KEY PLAN SHEET 3

DATE: SEPT. 28, 2017 | SCALE: 1" = 200' | SHEET **RWS-S-1003**



SCALE IN FEET

0 100 200 300

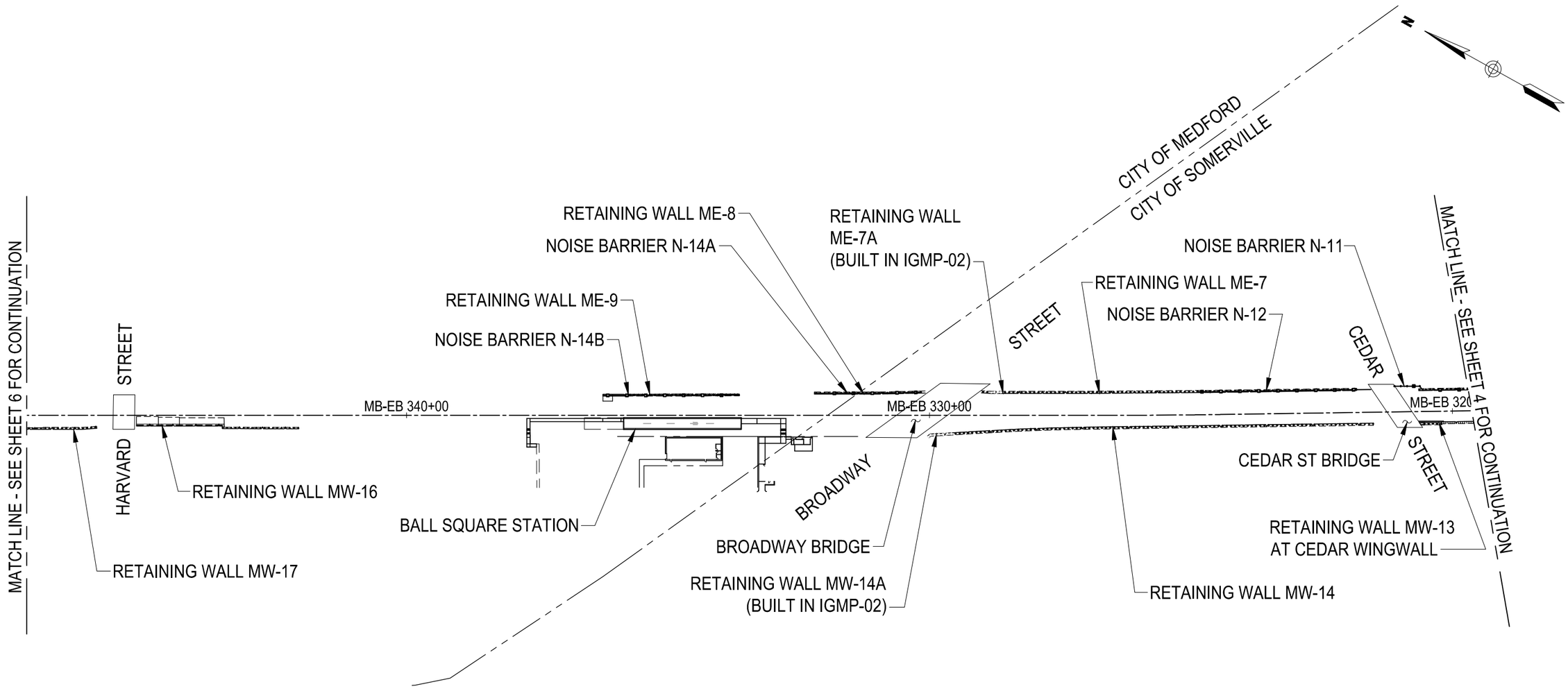
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD AND UNION BRANCH CORRIDOR WALL KEY PLAN SHEET 4

DATE: SEPT. 28, 2017 | SCALE: 1": 200□ | SHEET **RWS-S-1004**



SCALE IN FEET

0 100 200 300

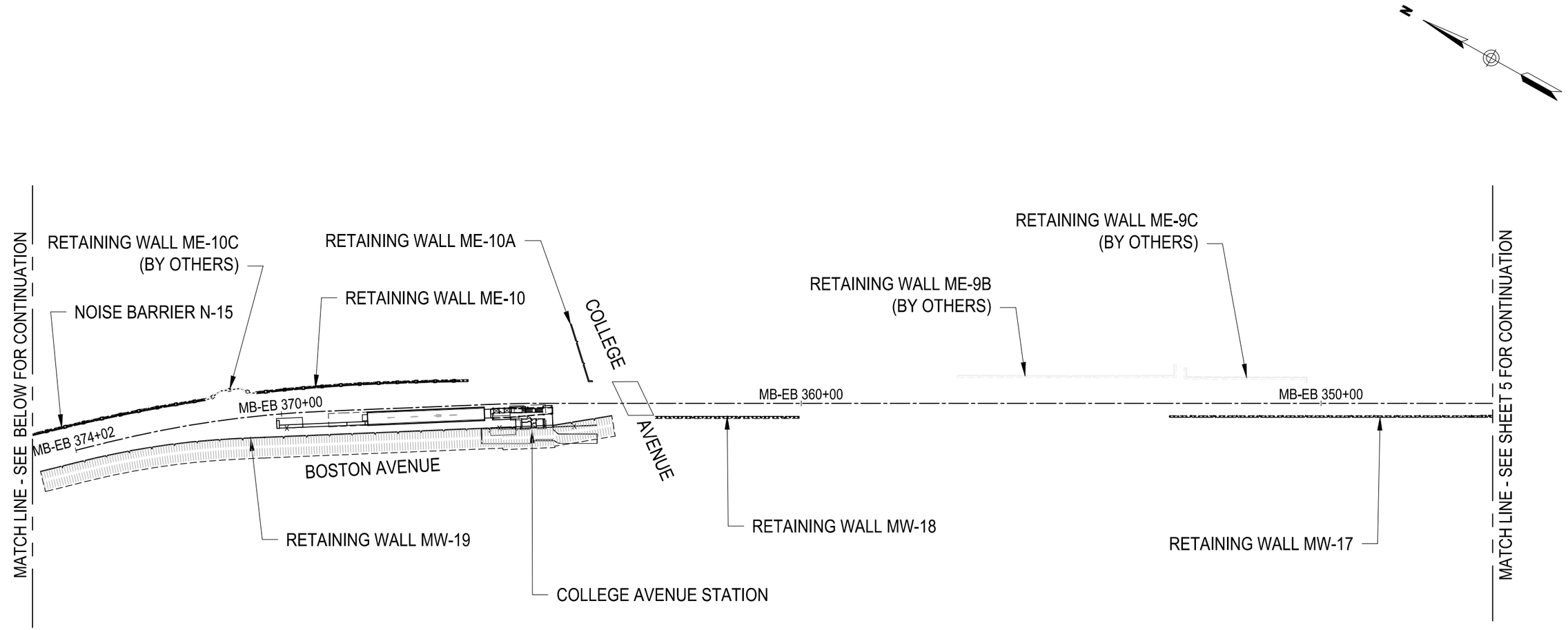
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

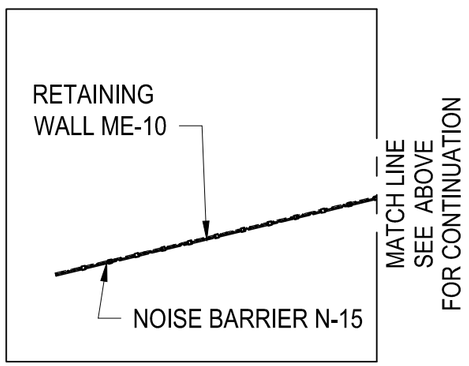
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD AND UNION BRANCH CORRIDOR WALL KEY PLAN SHEET 5

DATE: SEPT. 28, 2017 | SCALE: 1": 200□ | SHEET **RWS-S-1005**





SCALE IN FEET

0 100 200 300

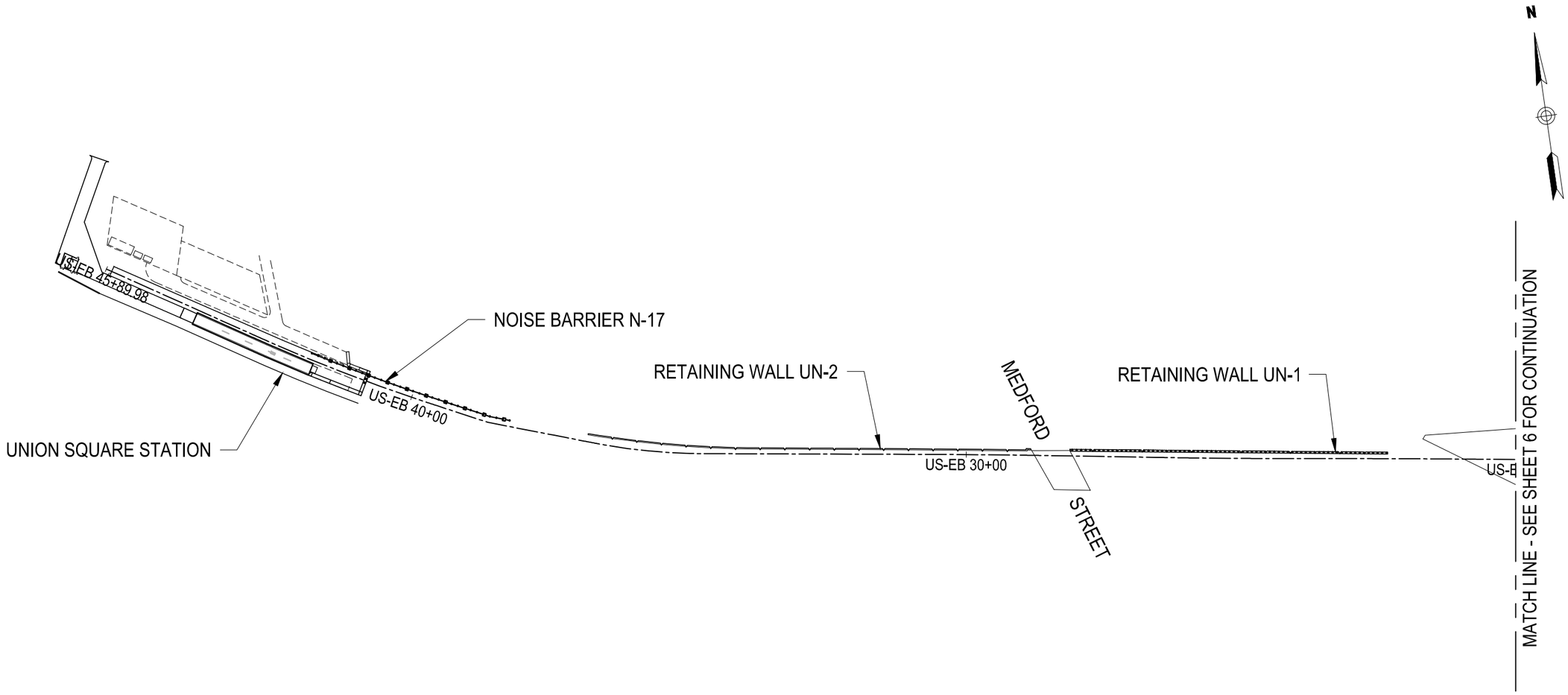
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD AND UNION BRANCH
CORRIDOR WALL KEY PLAN
SHEET 6

DATE: SEPT. 28, 2017 | SCALE: 1"□200□ | SHEET **RWS-S-1006**



SCALE IN FEET

0 100 200 300

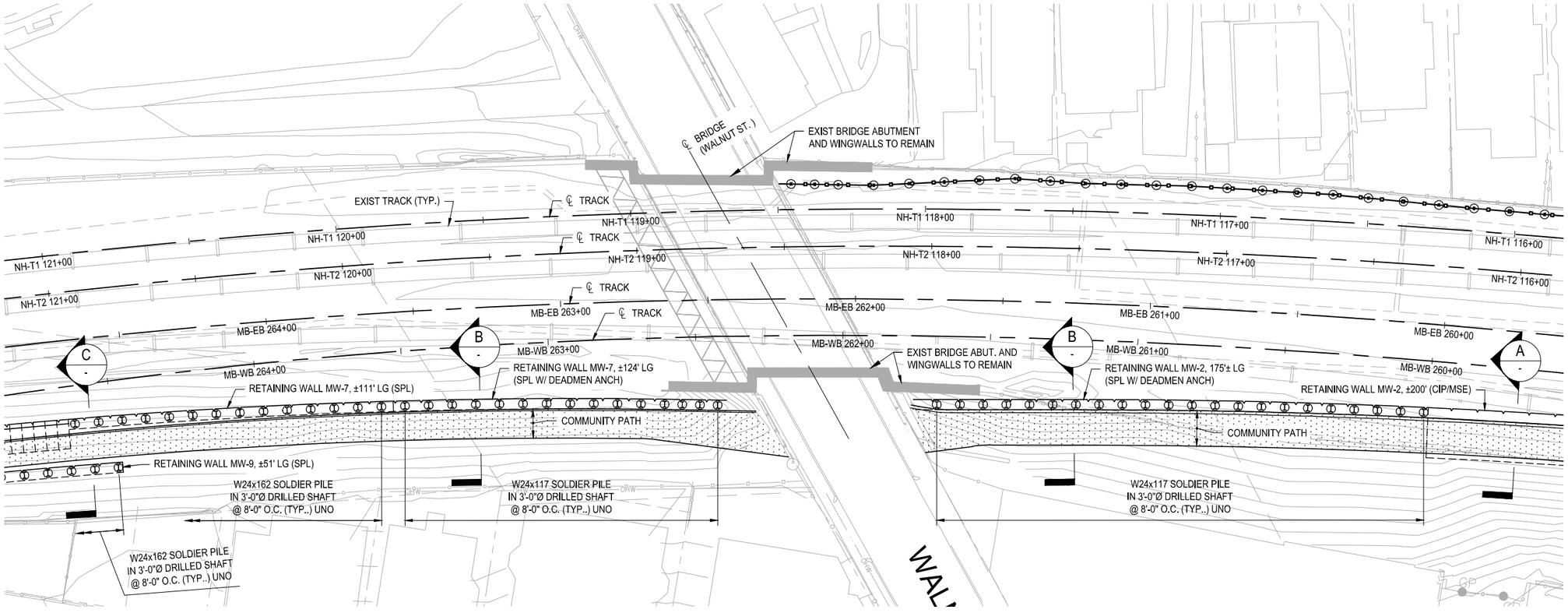
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD AND UNION BRANCH CORRIDOR WALL KEY PLAN SHEET 7

DATE: SEPT. 28, 2017 | SCALE: 1": 200□ | SHEET **RWS-S-1007**



PLAN - RETAINING WALL MW-2, MW-7 & MW-9

SCALE 1" = 20'

SCALE IN FEET

0 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

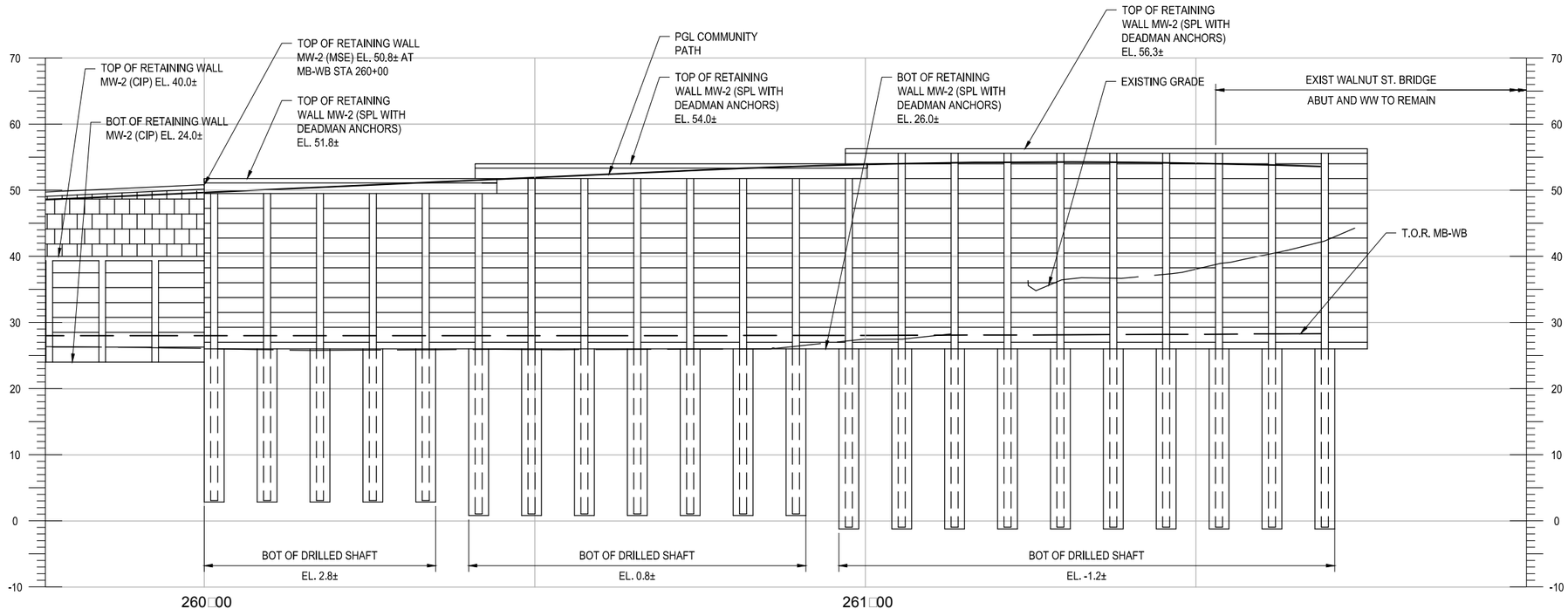
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH
CORRIDOR WALL PLAN
MB-WB STA 259+75 to STA 264+75

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **RWS-S-2001**


TOP OF RETAINING WALL MW-2 (CIP) EL. 40.0±
BOT OF RETAINING WALL MW-2 (CIP) EL. 24.0±
TOP OF RETAINING WALL MW-2 (MSE) EL. 50.8± AT MB-WB STA 260+00
TOP OF RETAINING WALL MW-2 (SPL WITH DEADMAN ANCHORS) EL. 51.8±
PGL COMMUNITY PATH
TOP OF RETAINING WALL MW-2 (SPL WITH DEADMAN ANCHORS) EL. 54.0±
BOT OF RETAINING WALL MW-2 (SPL WITH DEADMAN ANCHORS) EL. 26.0±
TOP OF RETAINING WALL MW-2 (SPL WITH DEADMAN ANCHORS) EL. 56.3±
EXISTING GRADE
EXIST WALNUT ST. BRIDGE
ABUT AND WW TO REMAIN
T.O.R. MB-WB
BOT OF DRILLED SHAFT EL. 2.8±
BOT OF DRILLED SHAFT EL. 0.8±
BOT OF DRILLED SHAFT EL. -1.2±
70
60
50
40
30
20
10
0
-10
260+00
261+00

DEVELOPED WALL ELEVATION MW-2 - WEST RETAINING WALL

SCALE 1"=10'

SCALE IN FEET

0 10 20 30

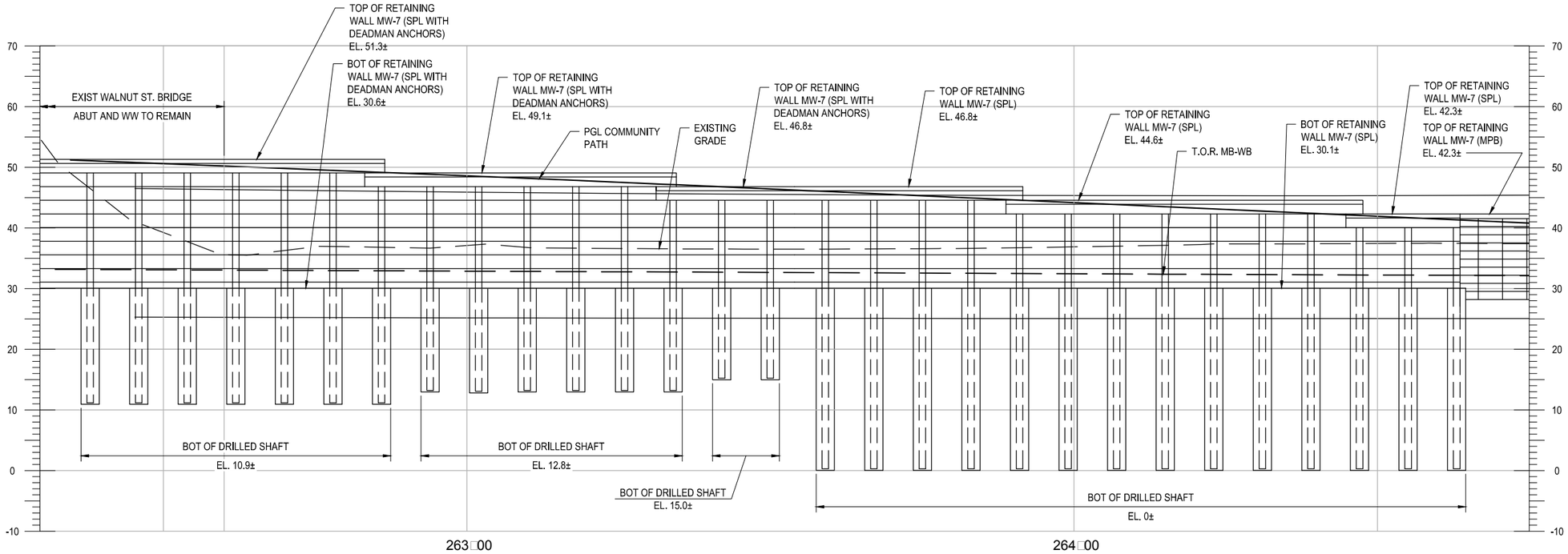
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH
WEST CORRIDOR WALL ELEVATION
MB-WB STA 259+75 to STA 262+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **RWS-S-3001**


TOP OF RETAINING WALL MW-7 (SPL WITH DEADMAN ANCHORS) EL. 51.3±
BOT OF RETAINING WALL MW-7 (SPL WITH DEADMAN ANCHORS) EL. 30.6±
TOP OF RETAINING WALL MW-7 (SPL WITH DEADMAN ANCHORS) EL. 49.1±
TOP OF RETAINING WALL MW-7 (SPL WITH DEADMAN ANCHORS) EL. 46.8±
TOP OF RETAINING WALL MW-7 (SPL) EL. 46.8±
TOP OF RETAINING WALL MW-7 (SPL) EL. 44.6±
TOP OF RETAINING WALL MW-7 (SPL) EL. 42.3±
TOP OF RETAINING WALL MW-7 (MPB) EL. 42.3±
BOT OF RETAINING WALL MW-7 (SPL) EL. 30.1±
EXIST WALNUT ST. BRIDGE ABUT AND WW TO REMAIN
PGL COMMUNITY PATH
EXISTING GRADE
T.O.R. MB-WB
BOT OF DRILLED SHAFT EL. 10.9±
BOT OF DRILLED SHAFT EL. 12.8±
BOT OF DRILLED SHAFT EL. 15.0±
BOT OF DRILLED SHAFT EL. 0±
70
60
50
40
30
20
10
0
-10
263+00
264+00

DEVELOPED WALL ELEVATION MW-7 - WEST RETAINING WALL

SCALE 1"=10'

SCALE IN FEET

0 10 20 30

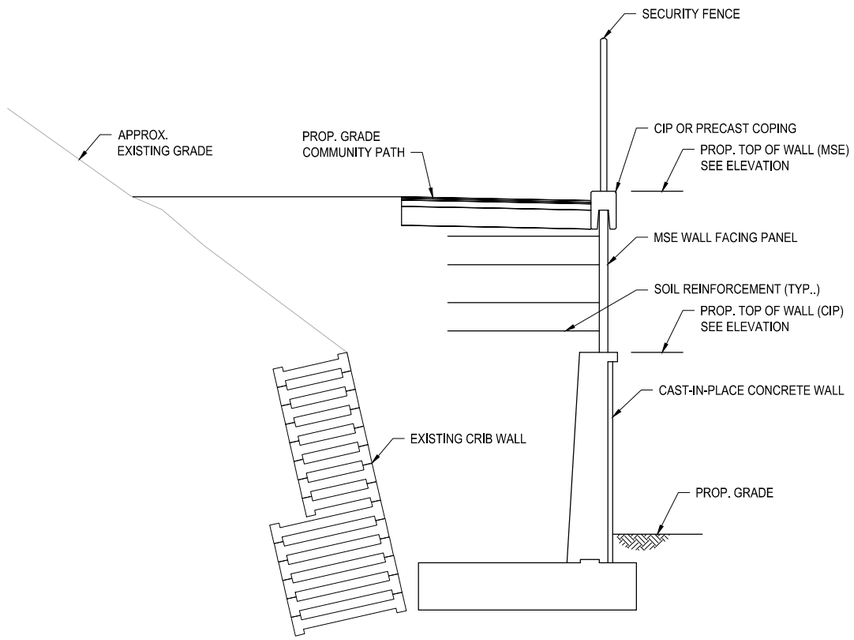
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

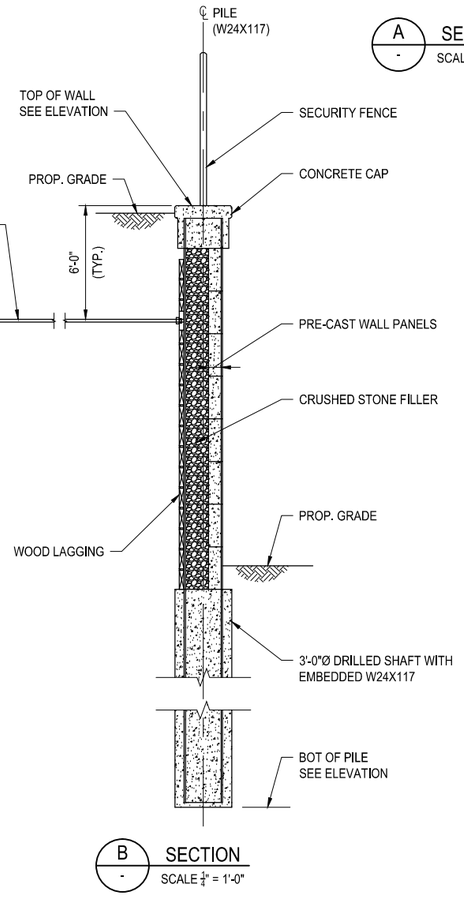
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH
WEST CORRIDOR WALL ELEVATION
MB-WB STA 262+25 to STA 264+75

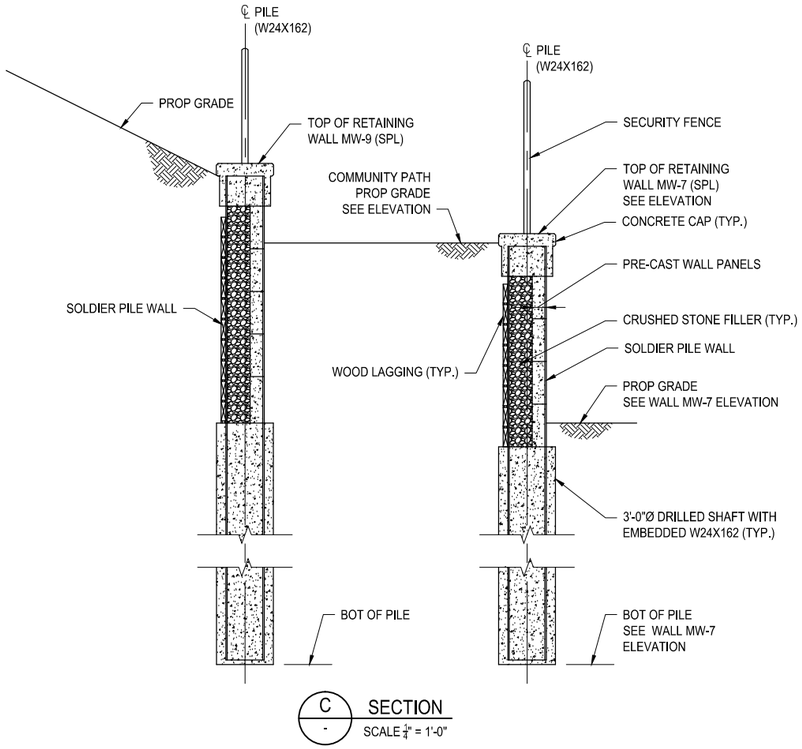
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **RWS-S-3002**



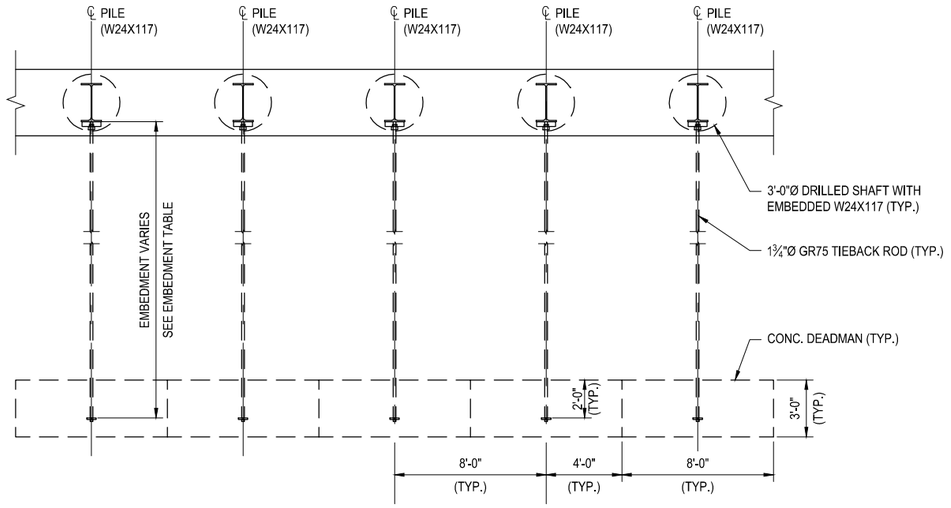
A SECTION
SCALE 1/4" = 1'-0"



B SECTION
SCALE 1/4" = 1'-0"


℄ PILE (W24X162)
℄ PILE (W24X162)
PROP GRADE
TOP OF RETAINING WALL MW-9 (SPL)
SECURITY FENCE
TOP OF RETAINING WALL MW-7 (SPL) SEE ELEVATION
COMMUNITY PATH PROP GRADE SEE ELEVATION
CONCRETE CAP (TYP.)
PRE-CAST WALL PANELS
SOLDIER PILE WALL
CRUSHED STONE FILLER (TYP.)
WOOD LAGGING (TYP.)
SOLDIER PILE WALL
PROP GRADE SEE WALL MW-7 ELEVATION
3'-0"Ø DRILLED SHAFT WITH EMBEDDED W24X162 (TYP.)
BOT OF PILE
BOT OF PILE SEE WALL MW-7 ELEVATION

C SECTION
SCALE 1/4" = 1'-0"



PARTIAL WALL PLAN
SCALE 1/2" = 1'-0"

TIEROD EMBEDMENT TABLE	
STATION (MB-WB)	EMBEDMENT LENGTH
260+00 TO 260+49	23'-2"
260+49 TO 260+97	25'-2"
260+97 TO 261+76	27'-3"
262+36 TO 262+92	15'-1"
262+92 TO 263+40	17'-1"
263+40 TO 263+51	19'-1"
272+40 TO 272+80	15'-1"
272+80 TO 273+28	17'-1"
273+28 TO 273+84	19'-1"
273+84 TO 274+32	21'-2"
274+32 TO 275+37	23'-2"

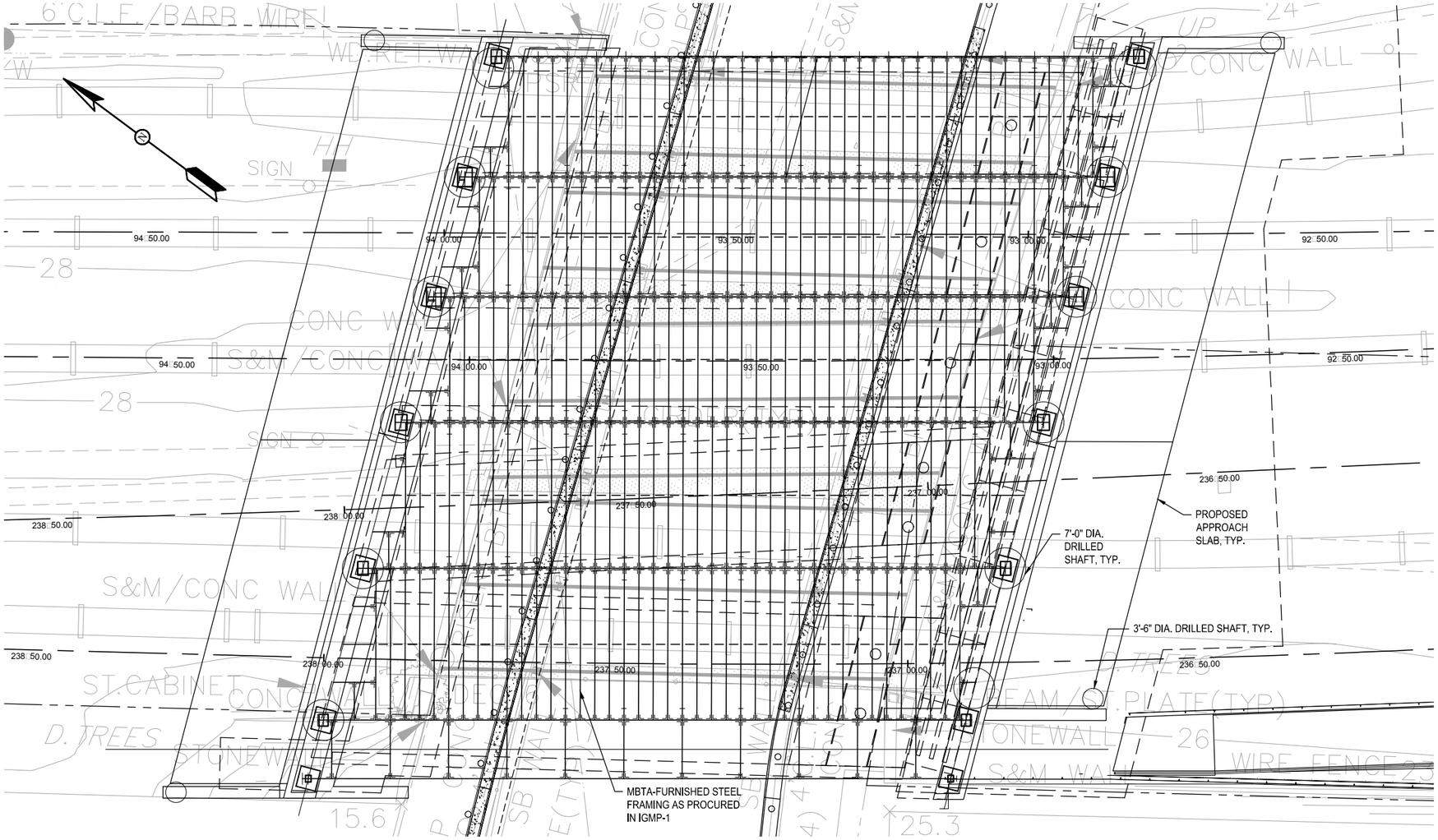
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH RETAINING WALL DETAILS

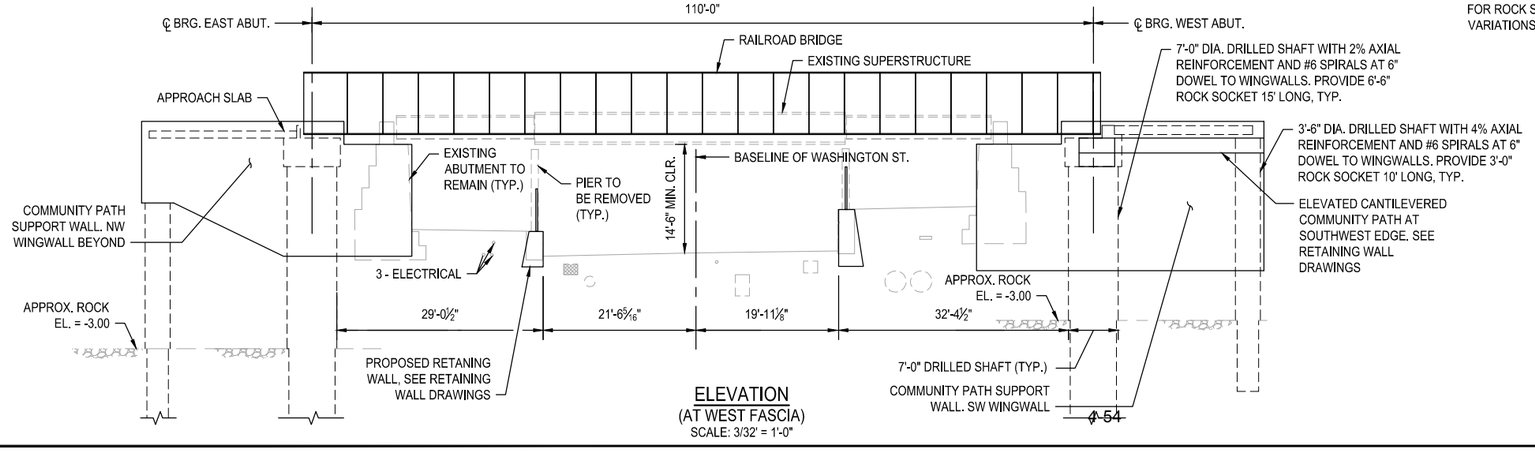
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET RWS-S-8001



KEY PLAN
SCALE: 3/32" = 1'-0"

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN, SEE BORING LOGS FOR ROCK SURFACE VARIATIONS


℄ BRG. EAST ABUT.
110'-0"
℄ BRG. WEST ABUT.
RAILROAD BRIDGE
EXISTING SUPERSTRUCTURE
APPROACH SLAB
EXISTING ABUTMENT TO REMAIN (TYP.)
PIER TO BE REMOVED (TYP.)
14'-6" MIN. CLR.
BASELINE OF WASHINGTON ST.
COMMUNITY PATH SUPPORT WALL. NW WINGWALL BEYOND
3 - ELECTRICAL
APPROX. ROCK EL. = -3.00
29'-0½"
21'-6⅝"
19'-11⅛"
32'-4½"
PROPOSED RETAINING WALL, SEE RETAINING WALL DRAWINGS
7'-0" DRILLED SHAFT (TYP.)
COMMUNITY PATH SUPPORT WALL. SW WINGWALL
7'-0" DIA. DRILLED SHAFT WITH 2% AXIAL REINFORCEMENT AND #6 SPIRALS AT 6" DOWEL TO WINGWALLS. PROVIDE 6'-6" ROCK SOCKET 15' LONG, TYP.
3'-6" DIA. DRILLED SHAFT WITH 4% AXIAL REINFORCEMENT AND #6 SPIRALS AT 6" DOWEL TO WINGWALLS. PROVIDE 3'-0" ROCK SOCKET 10' LONG, TYP.
ELEVATED CANTILEVERED COMMUNITY PATH AT SOUTHWEST EDGE. SEE RETAINING WALL DRAWINGS

ELEVATION
(AT WEST FASCIA)
SCALE: 3/32" = 1'-0"

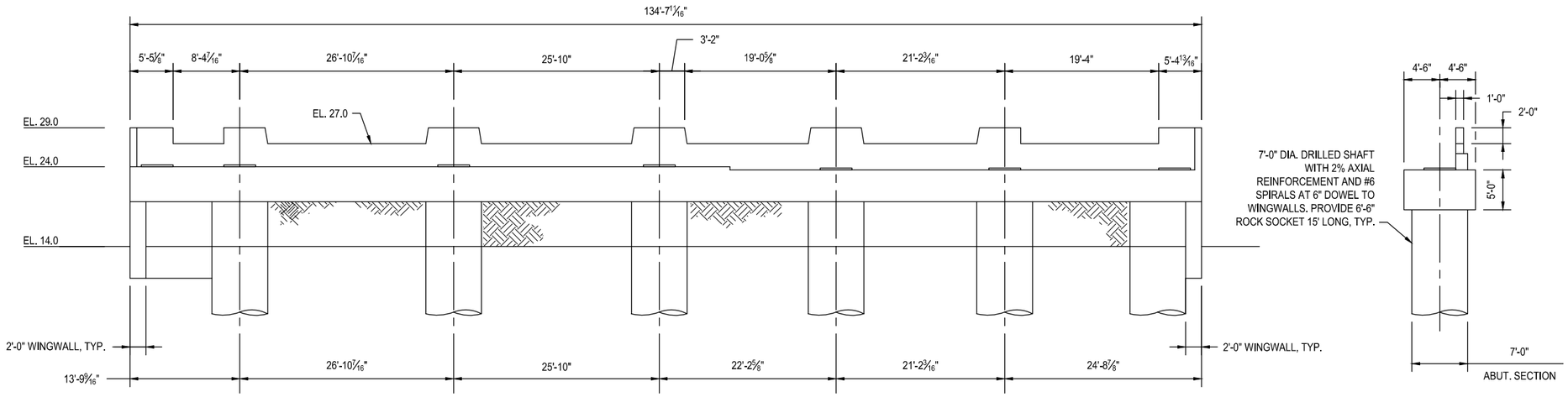
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

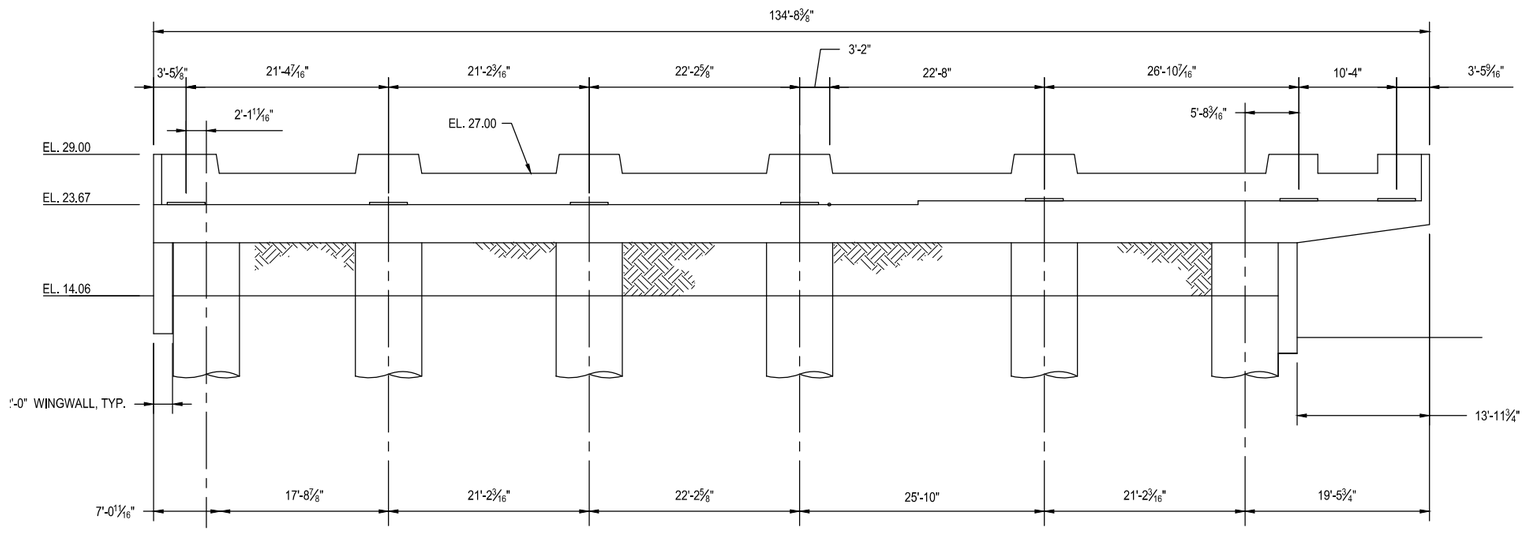
WASHINGTON STREET RAILROAD BRIDGE DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET WSB-S-2001



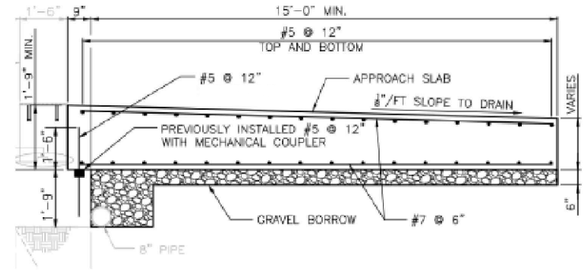
NORTH ABUTMENT ELEVATION

SCALE: 1/8" = 1'-0"



SOUTH ABUTMENT ELEVATION

SCALE: 1/8" = 1'-0"



APPROACH SLAB SECTION

NOT TO SCALE

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

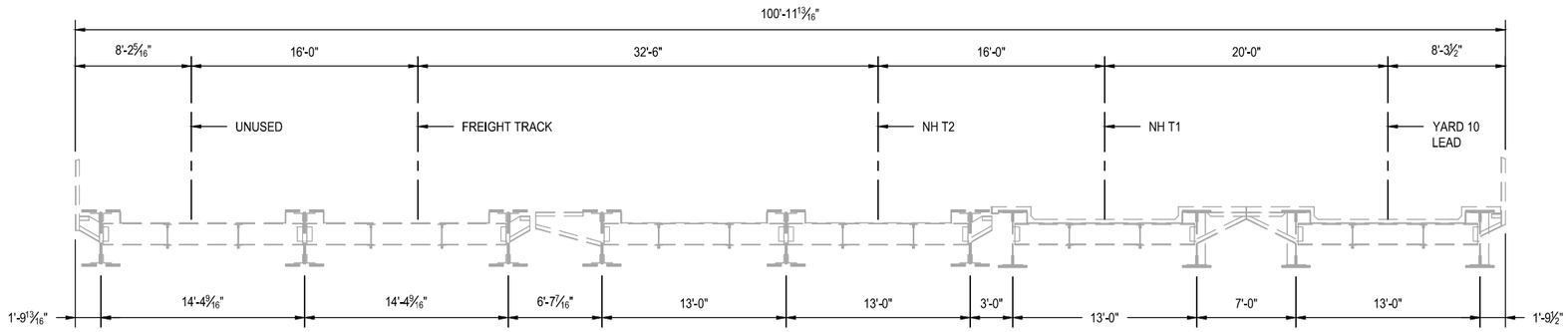
THE WALSH BARLETTA GRANITE

Joint Venture Team

WASHINGTON STREET RAILROAD BRIDGE

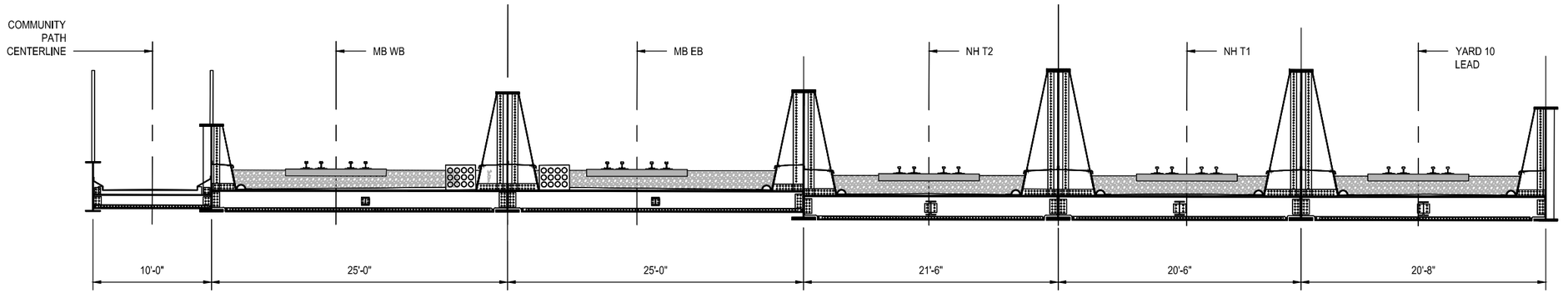
ABUTMENT ELEVATIONS

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET WSB-S-3001



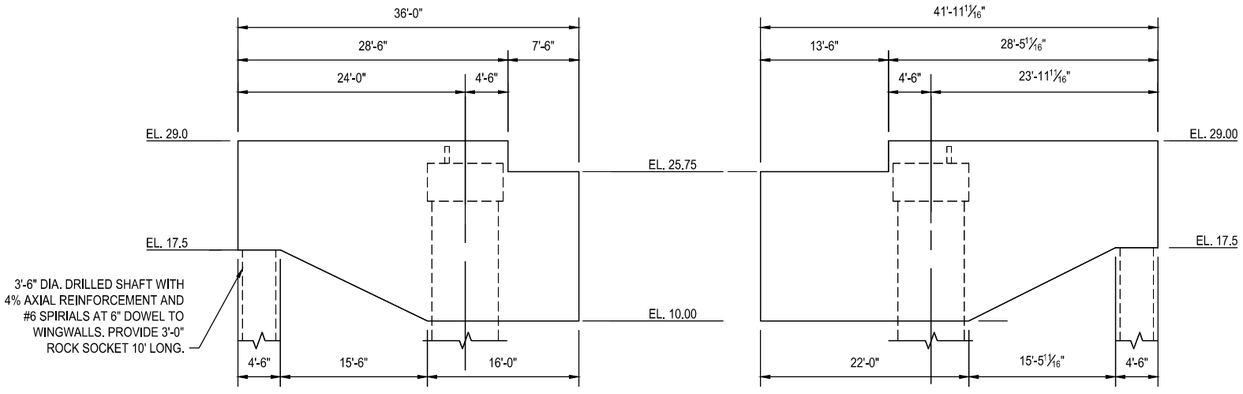
EXISTING TRANSVERSE SECTION

SCALE: 3/16' = 1'-0"



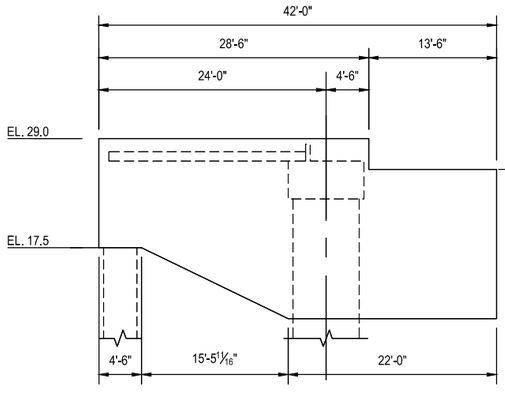
PROPOSED TRANSVERSE SECTION

SCALE: 3/16' = 1'-0"

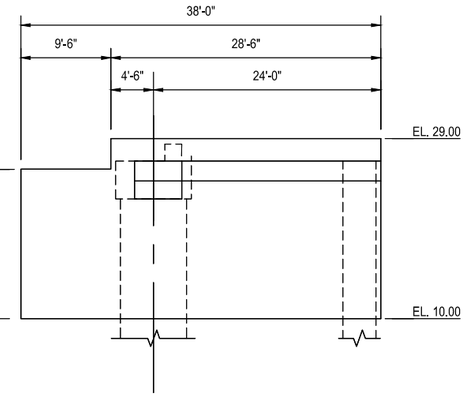


SOUTH EAST WINGWALL

NORTH EAST WINGWALL



NORTH WEST WINGWALL



SOUTH WEST WINGWALL

EAST WINGWALL ELEVATION

SCALE: 1/8' = 1'-0"

WEST WINGWALL ELEVATION

SCALE: 1/8' = 1'-0"

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

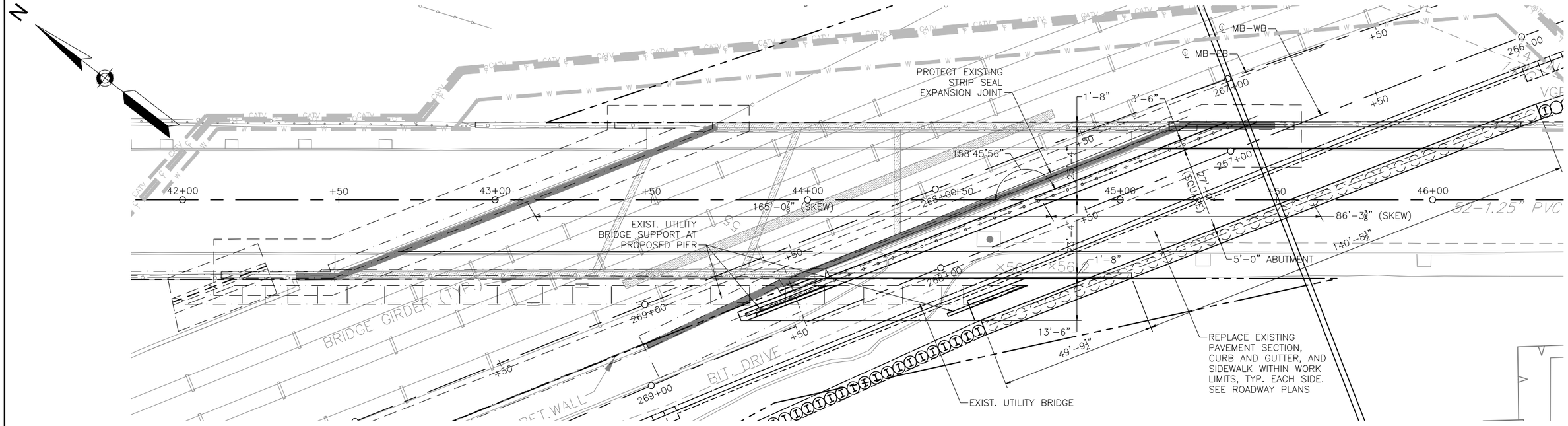
WALSH GRANITE

THE WALSH BARLETTA GRANITE

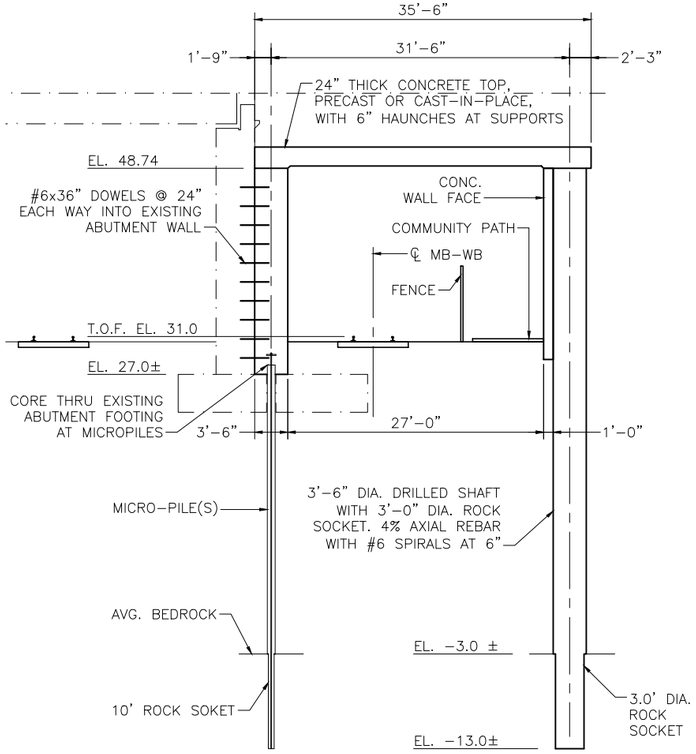
Joint Venture Team

WASHINGTON STREET RAILROAD BRIDGE TRANSVERSE SECTIONS

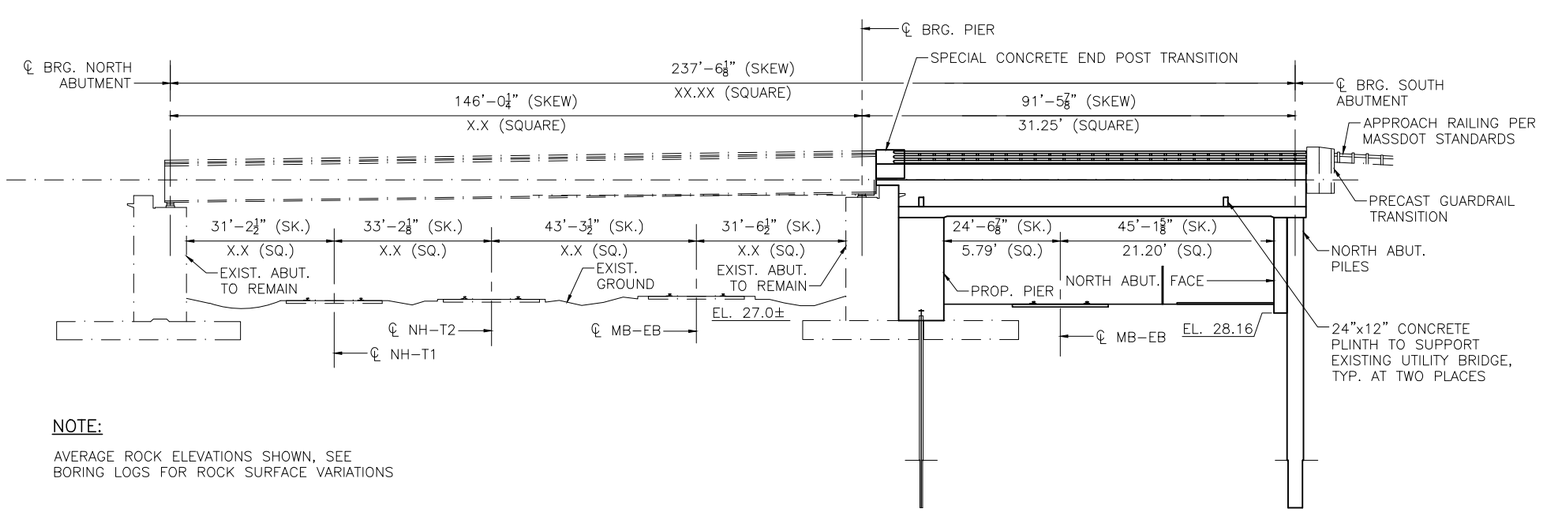
DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET WSB-S-4001



DECK PLAN
SCALE: 1/16" = 1'–0"



PROPOSED SECTION NORMAL TO ABUTMENT BEARING
SCALE: 1/16" = 1'–0"



NOTE:

AVERAGE ROCK ELEVATIONS SHOWN, SEE BORING LOGS FOR ROCK SURFACE VARIATIONS

PROPOSED LONGITUDINAL SECTON
SCALE: 1/16" = 1'–0"

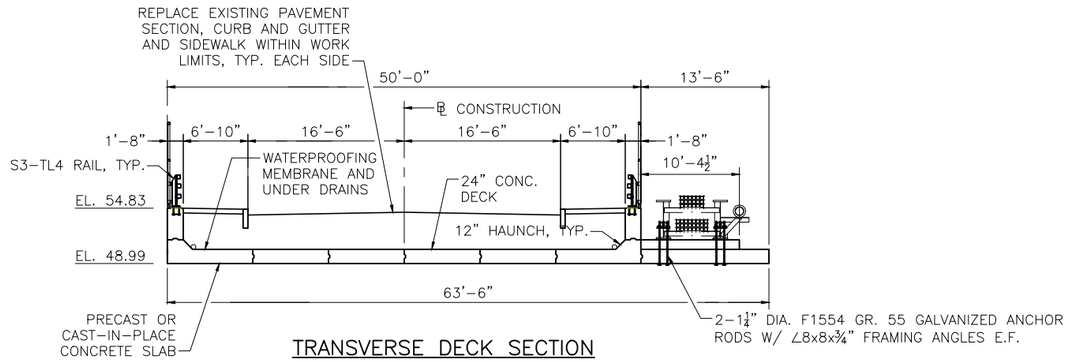
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

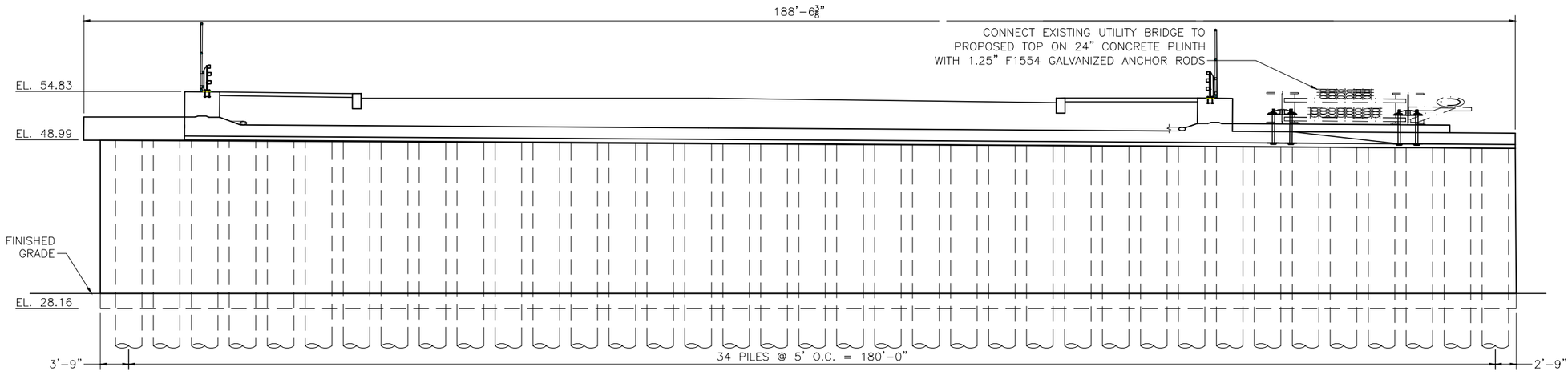
MEDFORD STREET BRIDGE
DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET MEB-S-2001



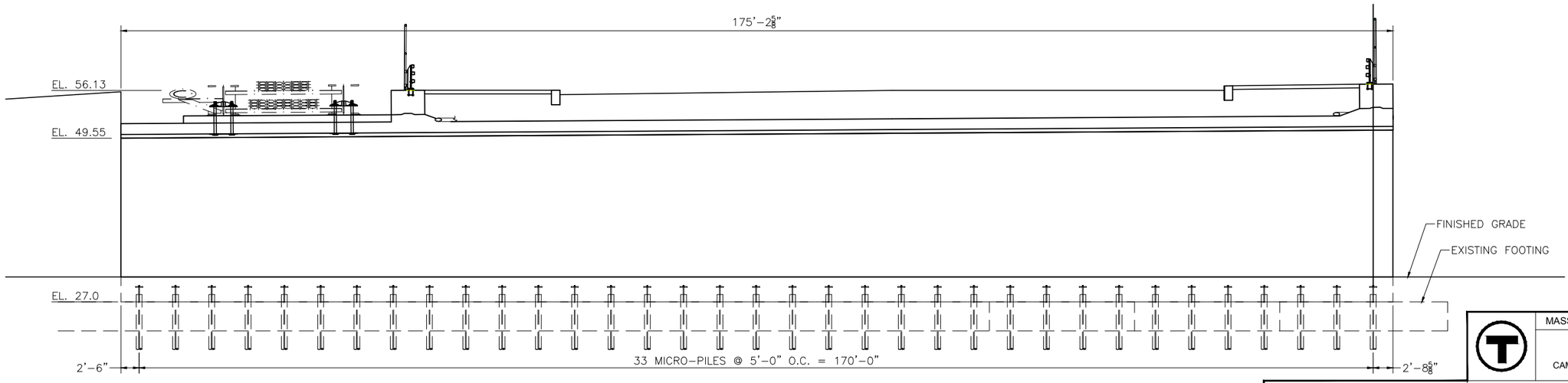
TRANSVERSE DECK SECTION

SCALE: 1/8" = 1'-0"



SOUTH ABUTMENT ELEVATION

SCALE: 1/8" = 1'-0"



PIER ELEVATION

(NOTHERN FACE)

SCALE: 1/8" = 1'-0"

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

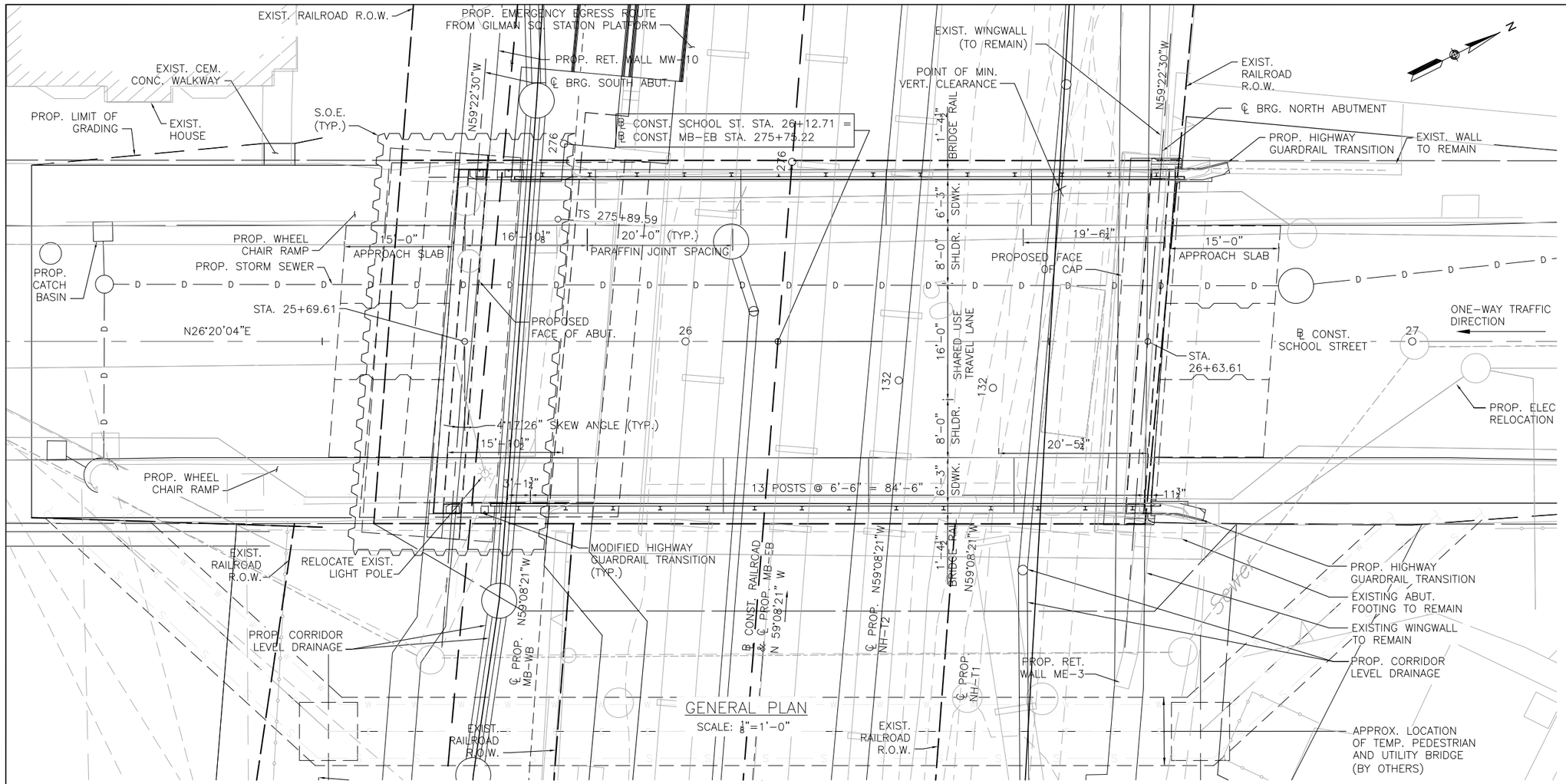
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD STREET BRIDGE
ABUTMENT ELEVATIONS

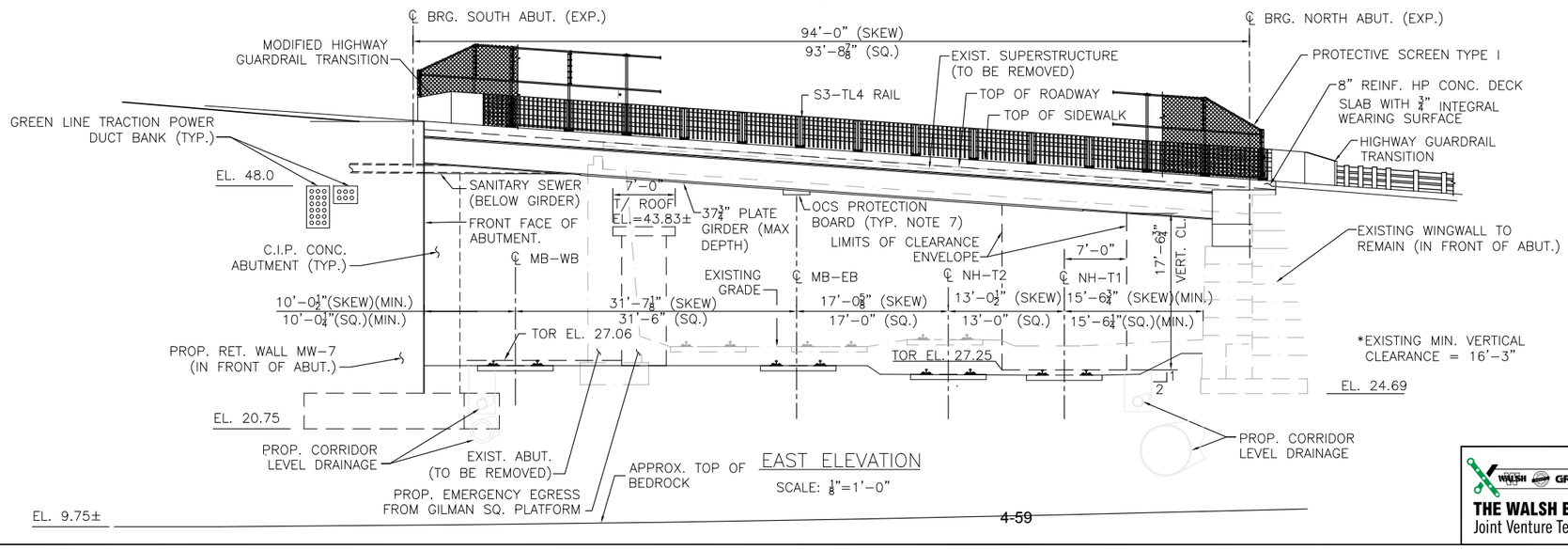
WALSH GRANITE

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET MEB-S-3001



GENERAL PLAN
SCALE: ⅛"=1'-0"



EAST ELEVATION
SCALE: ⅛"=1'-0"

ATC 3

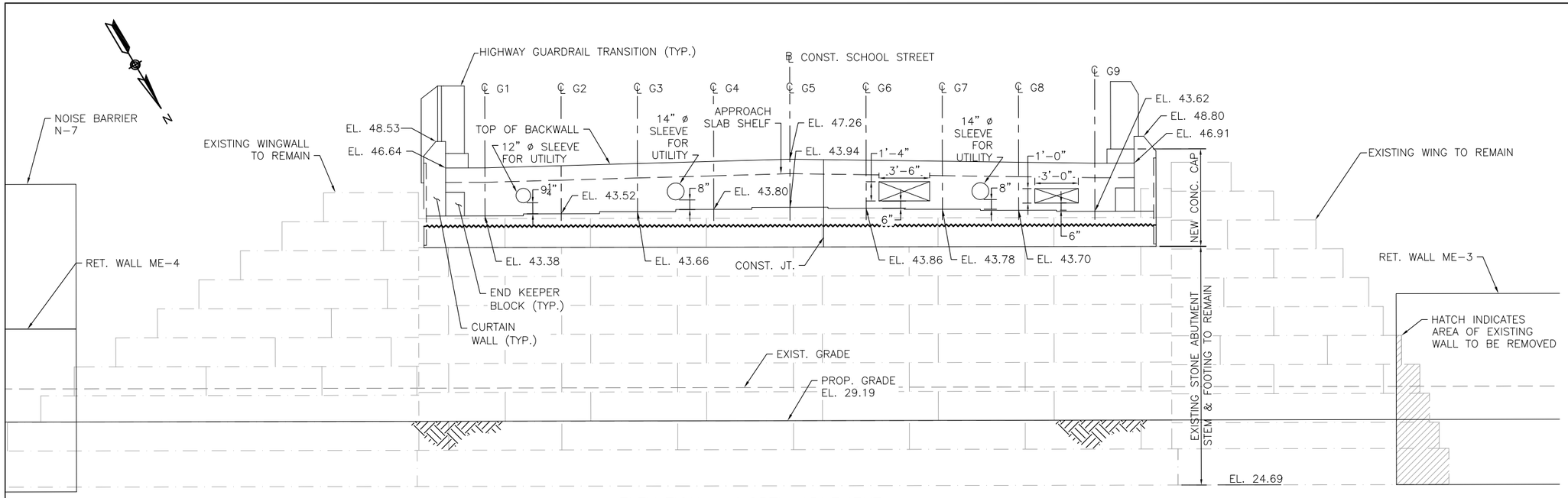
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

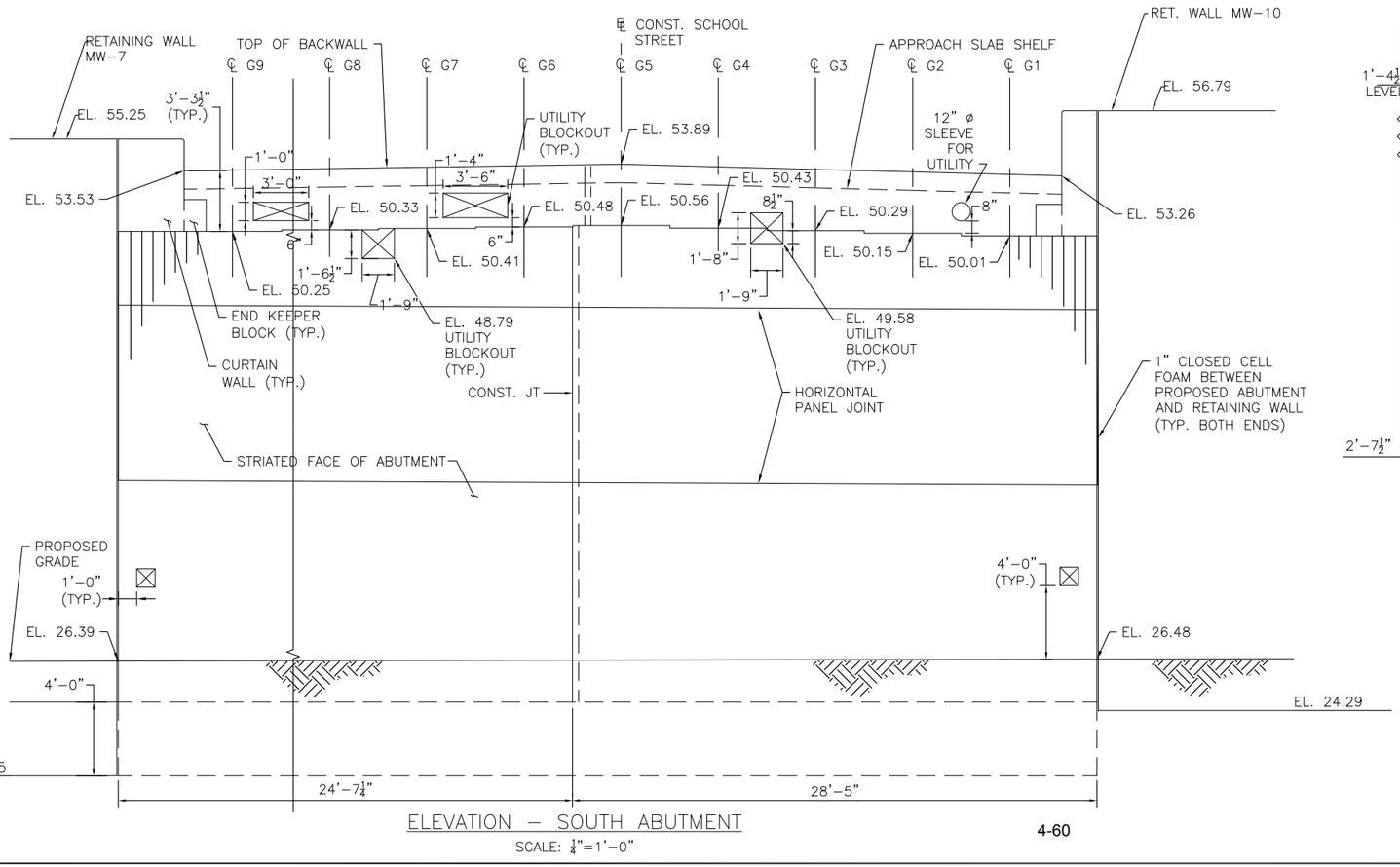
SCHOOL STREET BRIDGE GENERAL PLAN & EAST ELEVATION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET SCB-S-2001



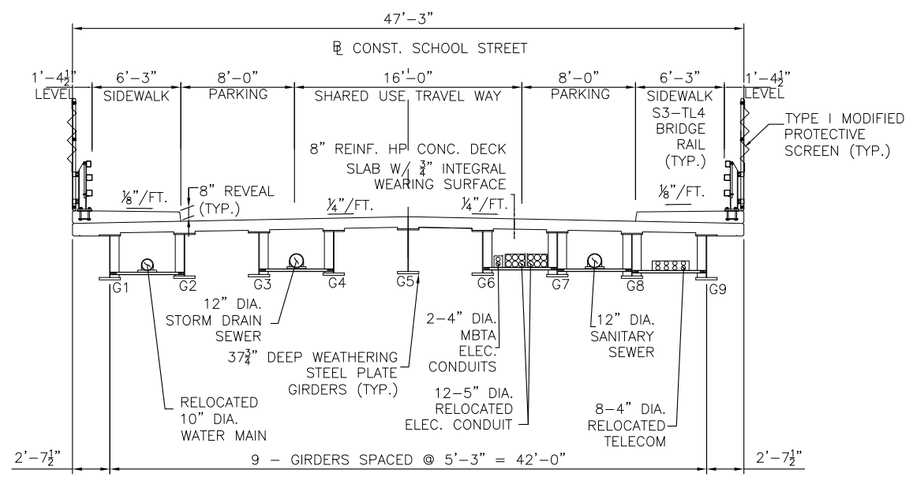
ELEVATION – NORTH ABUTMENT

SCALE: ¼"=1'-0"



ELEVATION – SOUTH ABUTMENT

SCALE: ¼"=1'-0"



TRANSVERSE SECTION – LOOKING NORTH

SCALE: 3/16"=1'-0"

ATC 3

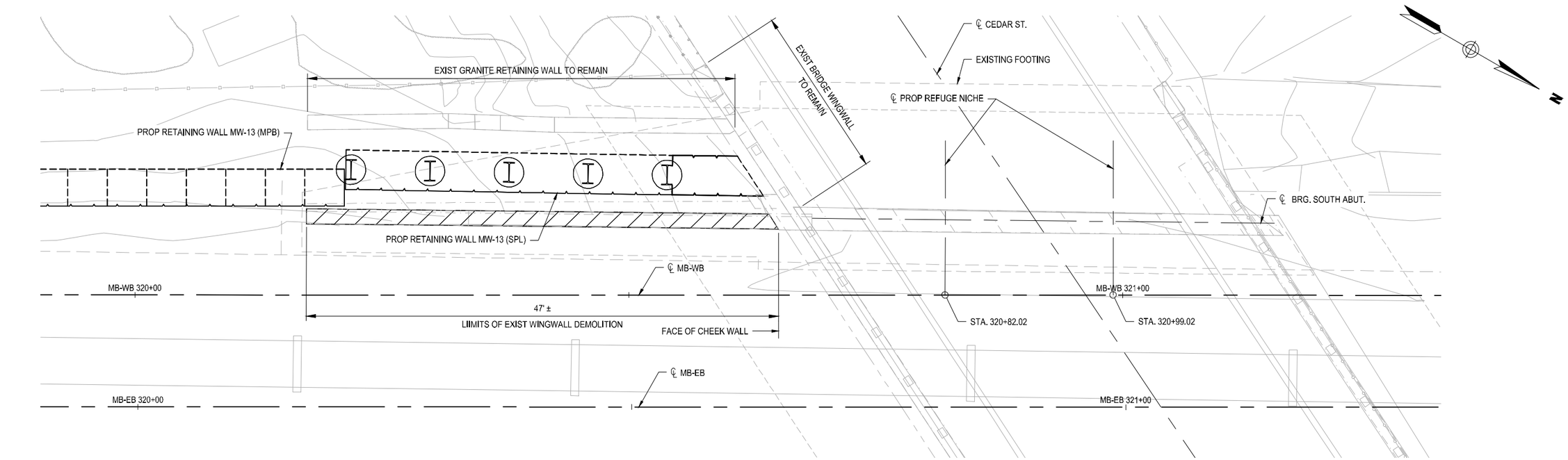
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

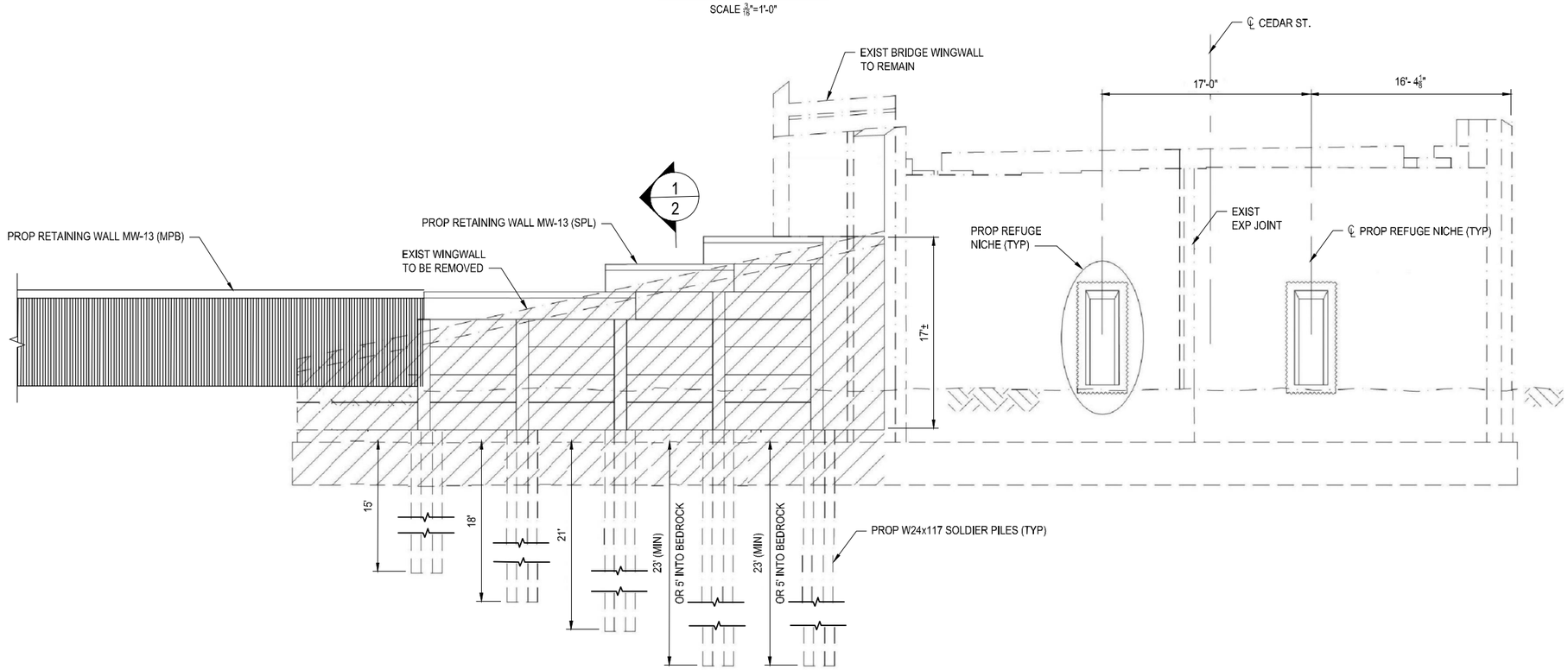
SCHOOL STREET BRIDGE
NORTH & SOUTH ABUTMENT ELEVATION AND TRANSVERSE SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET SCB-S-3001



SOUTH ABUTMENT PLAN

SCALE $\frac{3}{16}$"=1'-0"



SOUTH ABUTMENT ELEVATION

SCALE $\frac{3}{16}$"=1'-0"

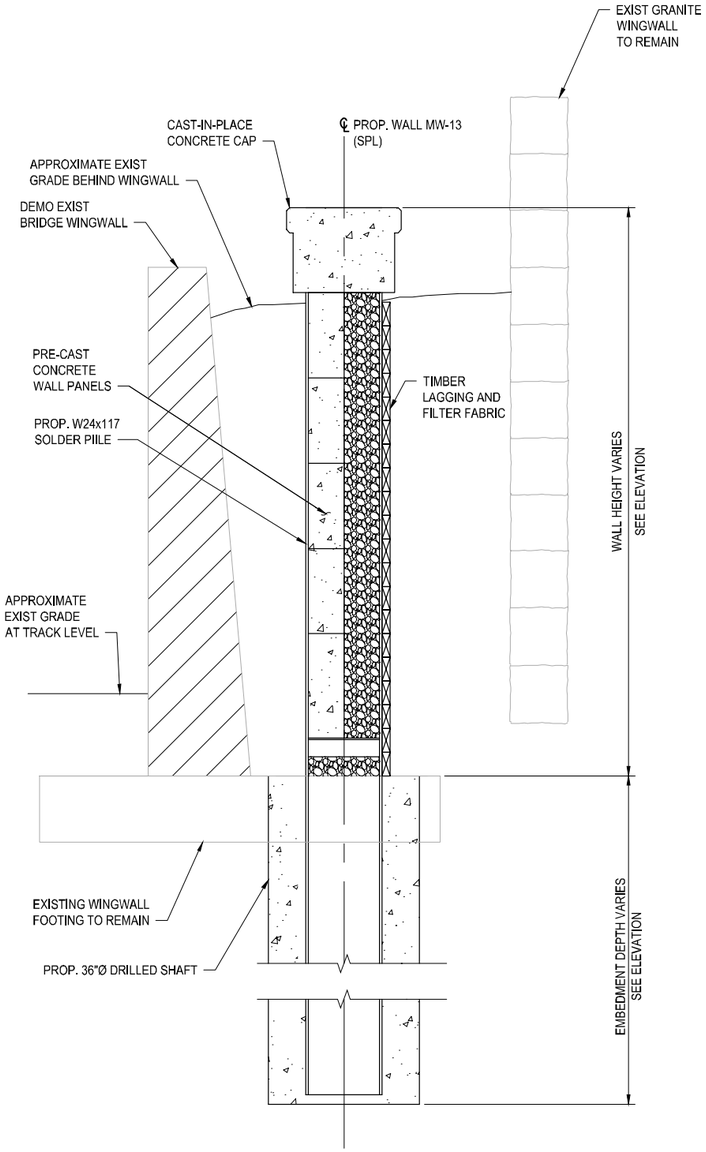
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

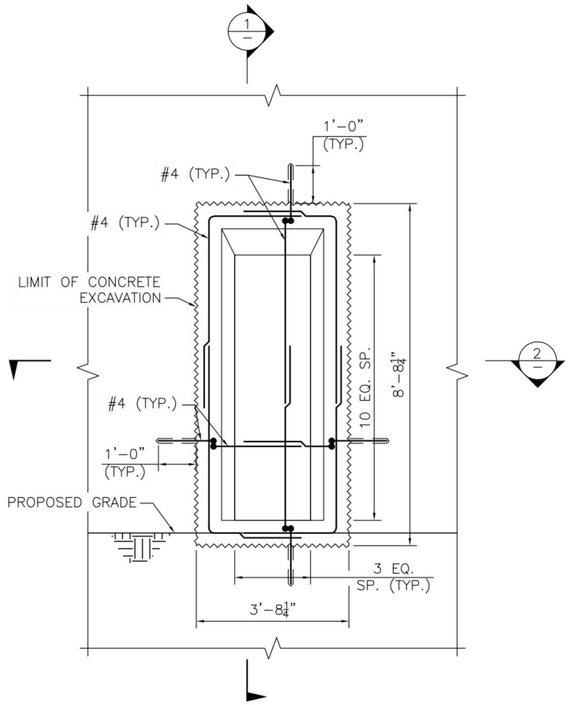
CEDAR STREET BRIDGE
SOUTH ABUTMENT
PLAN AND ELEVATION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET CEB-S-2001


EXIST GRANITE WINGWALL TO REMAIN
CAST-IN-PLACE CONCRETE CAP
℄ PROP. WALL MW-13 (SPL)
APPROXIMATE EXIST GRADE BEHIND WINGWALL
DEMO EXIST BRIDGE WINGWALL
PRE-CAST CONCRETE WALL PANELS
PROP. W24x117 SOLDER PIILE
TIMBER LAGGING AND FILTER FABRIC
WALL HEIGHT VARIES SEE ELEVATION
APPROXIMATE EXIST GRADE AT TRACK LEVEL
EXISTING WINGWALL FOOTING TO REMAIN
PROP. 36"Ø DRILLED SHAFT
EMBEDMENT DEPTH VARIES SEE ELEVATION

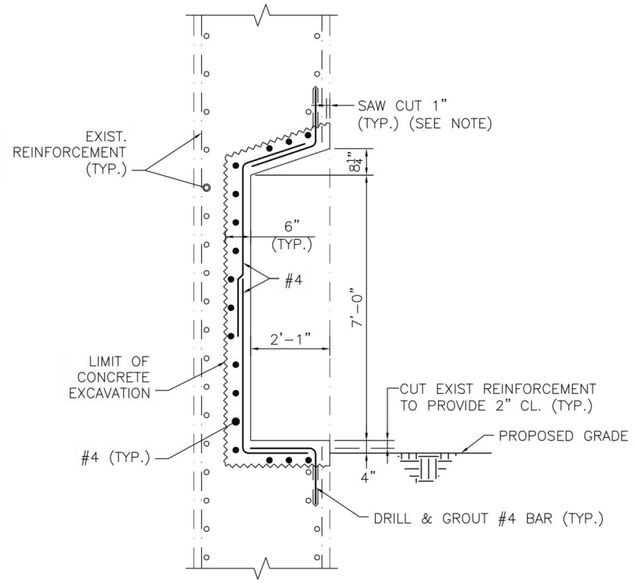
SECTION 1

SCALE $\frac{1}{2}$"=1'-0"



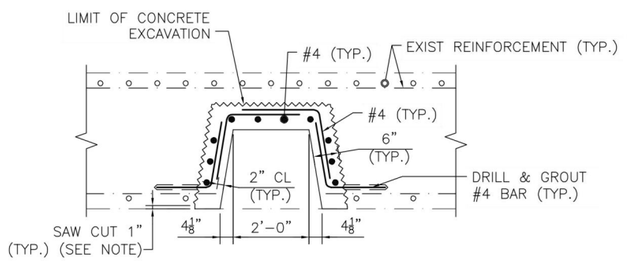
NICHE DETAIL

SCALE $\frac{1}{2}$"=1'-0"



SECTION 1

SCALE: $\frac{1}{2}$"=1'-0"



SECTION 2

SCALE: $\frac{1}{2}$"=1'-0"

NOTE:
SAWCUT OPENING 1" DEEP BEFORE CONCRETE EXCAVATION

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

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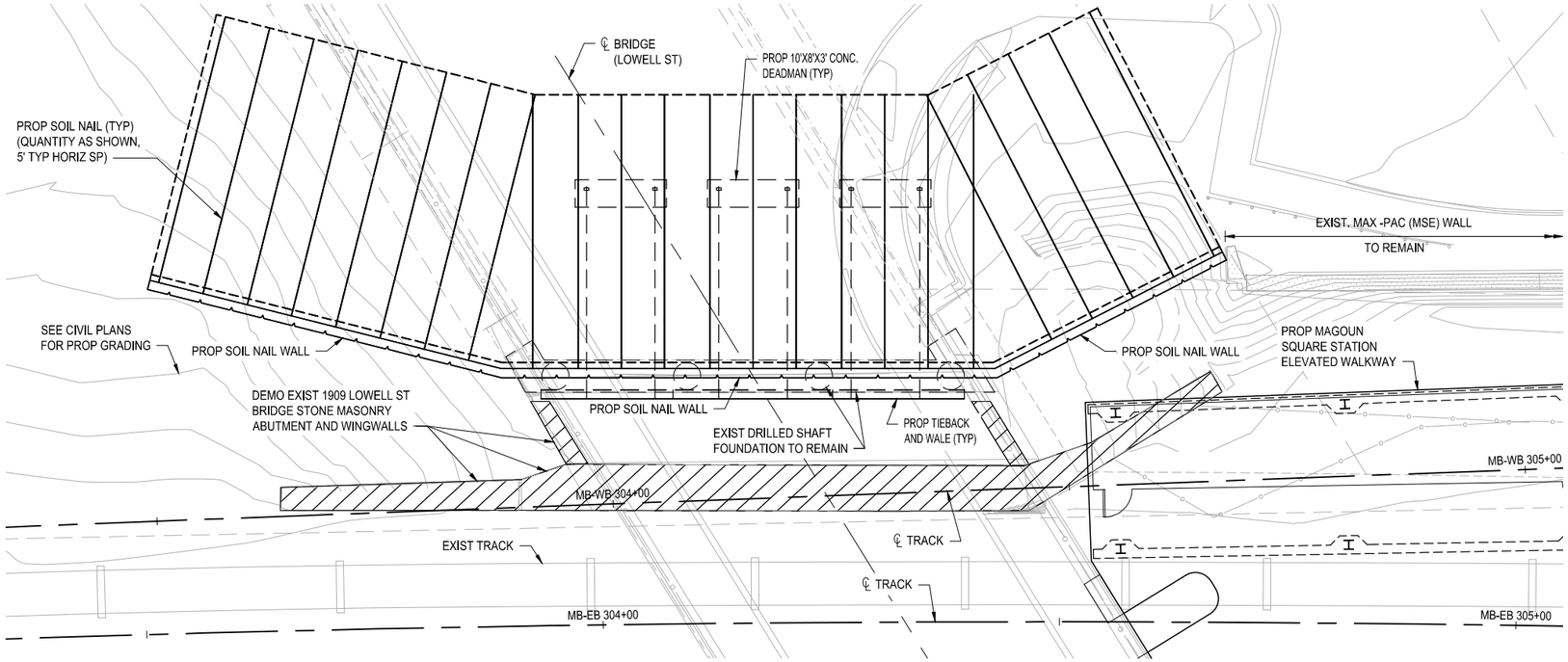
THE WALSH BARLETTA GRANITE
Joint Venture Team

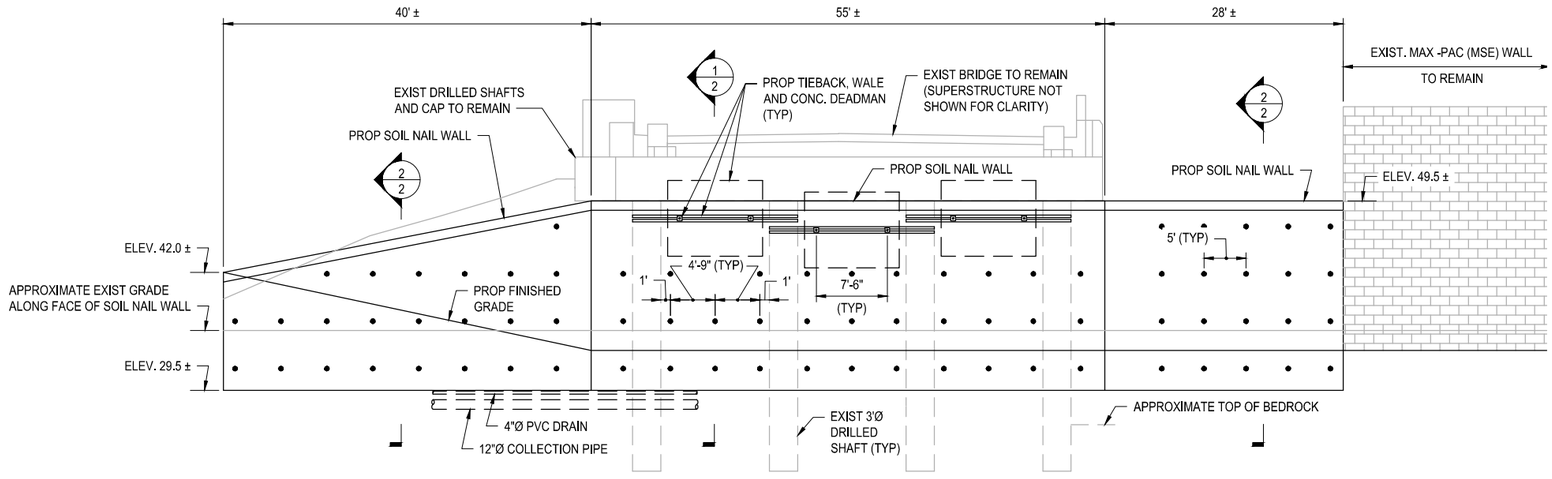
CEDAR STREET BRIDGE
SOUTH ABUTMENT
SECTION AND DETAILS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **CEB-S-8001**



SOUTH ABUTMENT PLAN

SCALE $\frac{3}{8}$"=1'-0"



SOUTH ABUTMENT ELEVATION

SCALE $\frac{3}{8}$"=1'-0"

NOTE:
CONTRACTOR TO VERIFY THE ELEVATIONS OF EXISTING ADJACENT FOOTINGS.

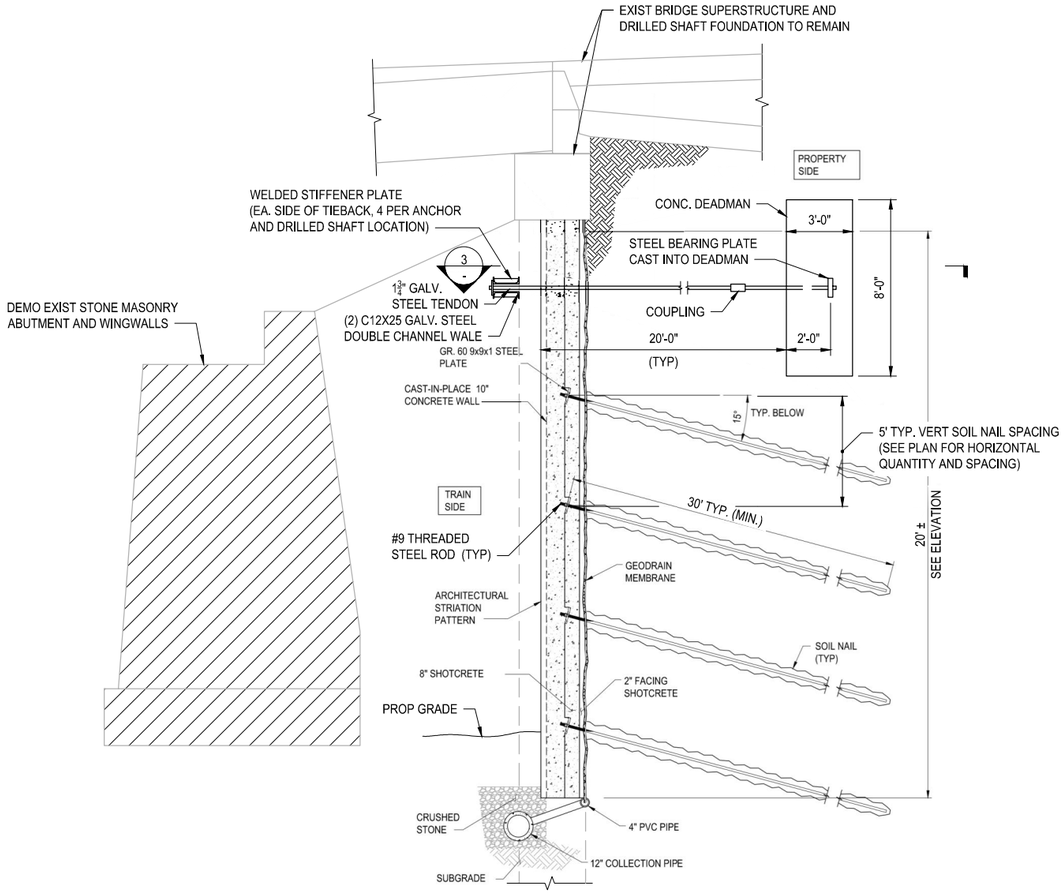
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

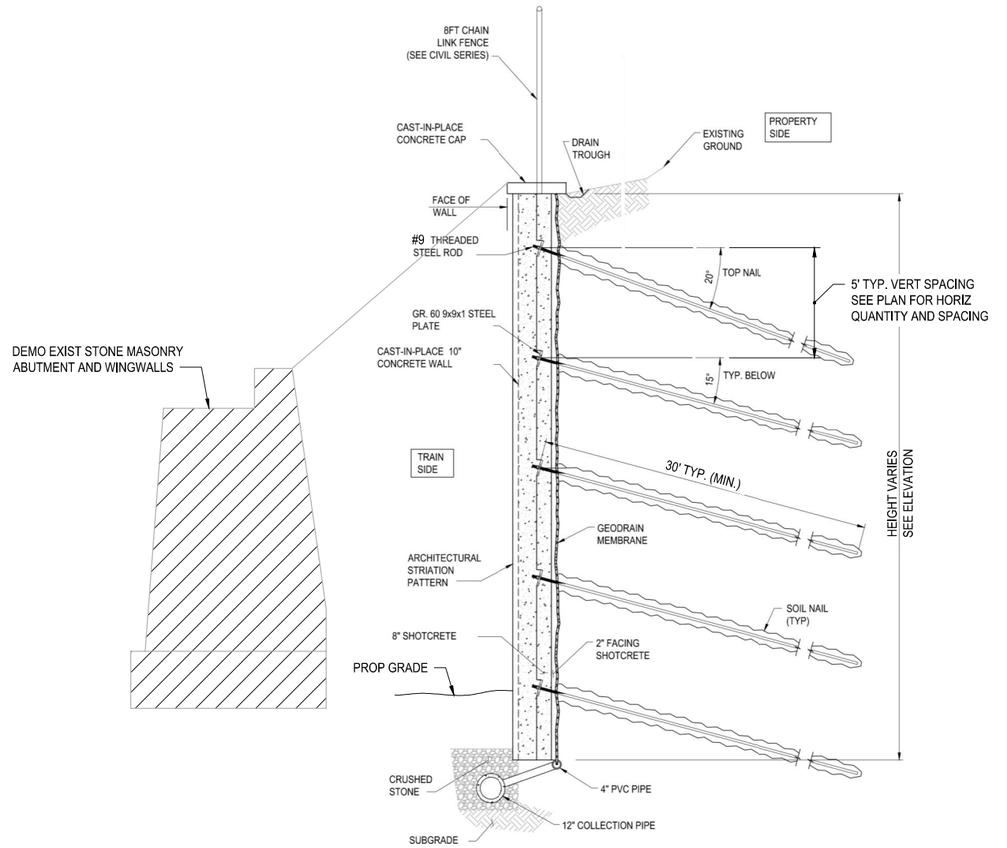
LOWELL STREET BRIDGE
SOUTH ABUTMENT
PLAN AND ELEVATION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **LOB-S-2001**



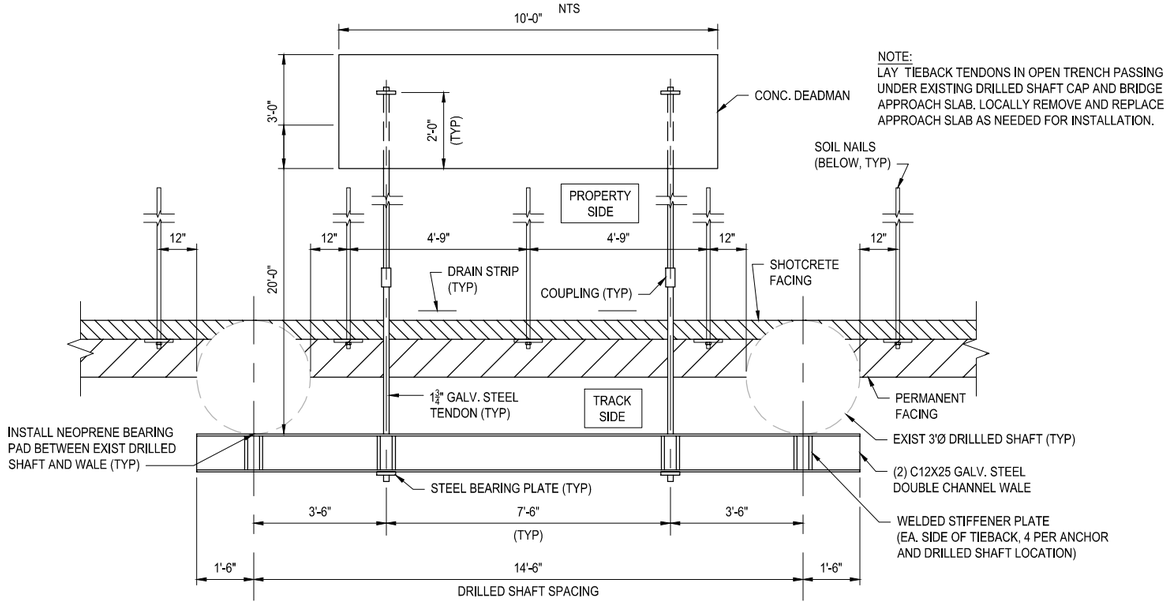
SECTION THRU ABUTMENT - SECTION 1

NTS



SECTION THRU WINGWALL - SECTION 2

NTS



HORIZONTAL SECTION THRU ABUTMENT - SECTION 3

NTS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

LOWELL STREET BRIDGE
SOUTH ABUTMENT
SOIL NAIL WALL SECTIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **LOB-S-8001**

WINGWALL

146'-4 1/8"

+04.41
CS 331+00

+80.98
SC

+20.98
TS

N

73+00 +50 74+00 +50 75+00

℄ ABUTMENT

3'-6" DIA. PILES, TYP.

℄ MB-WB

330+00

℄ PIER

3'-3" DIA. PILES

EXISTING UTILITY BRIDGE TO REMAIN. PAINT GIRDERS PER TECHNICAL PROVISIONS

52'-11" DECK

8'-8"
5'-0"
12'-0" (TRAVEL LANE)
12'-0" (TRAVEL LANE)
5'-0"
7'-6"

8'-9"

186+00

EXISTING ABUTMENT

EDGE OF DECK

℄ EAST ABUTMENT

℄ MB-EB

+02.21
℄ BS
85+00

DECK PLAN
SCALE: 1/8" = 1'-0"

℄ WEST ABUTMENT — 142'-0" — ℄ EAST ABUTMENT

53'-0" | 89'-0"

PIER

℄ MB-WB ℄ MB-EB ℄ NH-T2 ℄ NH-T1

EXISTING ABUTMENT

EST. ROCK

LONGITUDINAL SECTION
SCALE: 1/8" = 1'-0"

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN. SEE BORING LOGS FOR ROCK SURFACE VARIATIONS

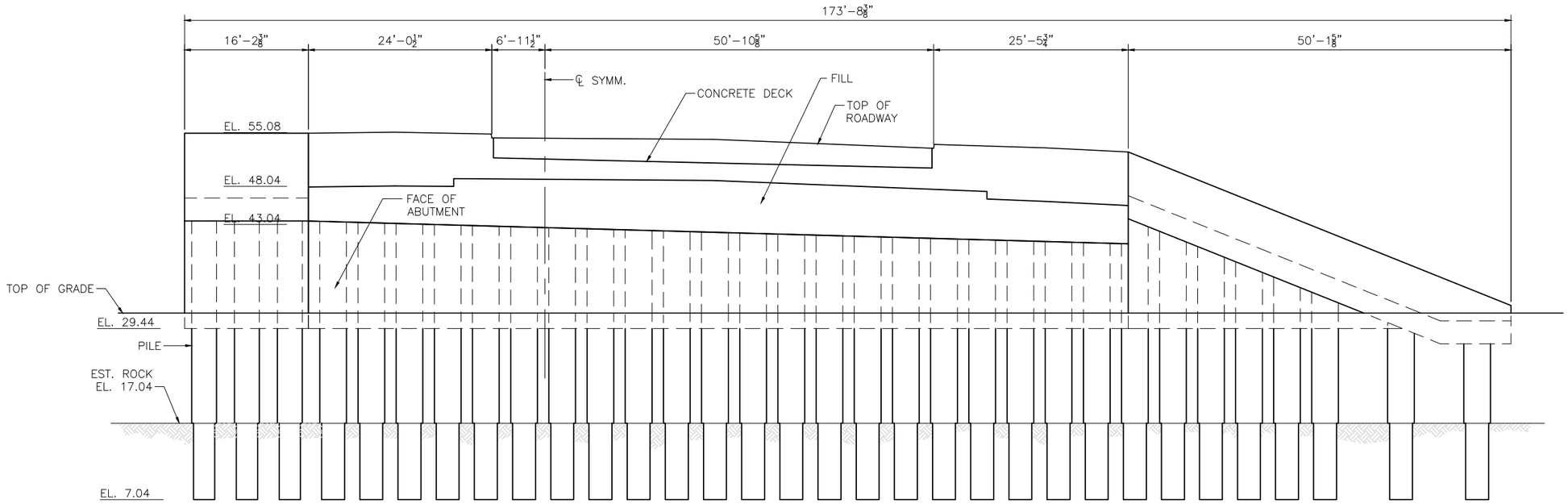
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

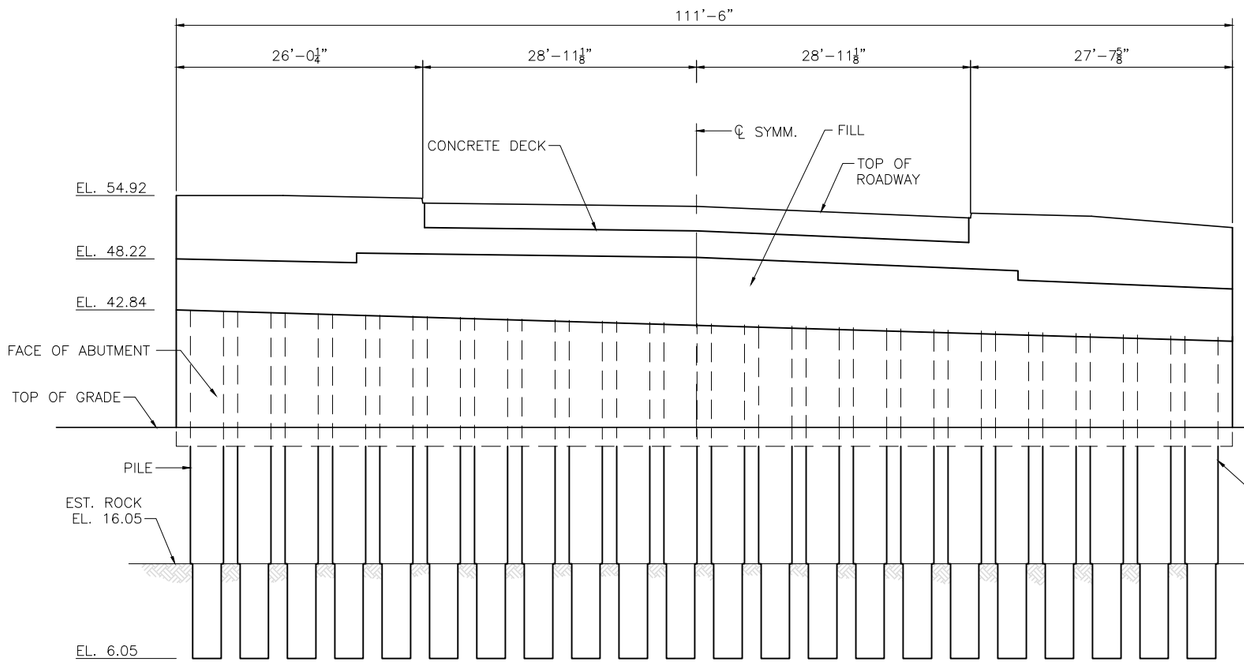
THE WALSH BARLETTA GRANITE
Joint Venture Team

BROADWAY BRIDGE
DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET BRB-S-2001



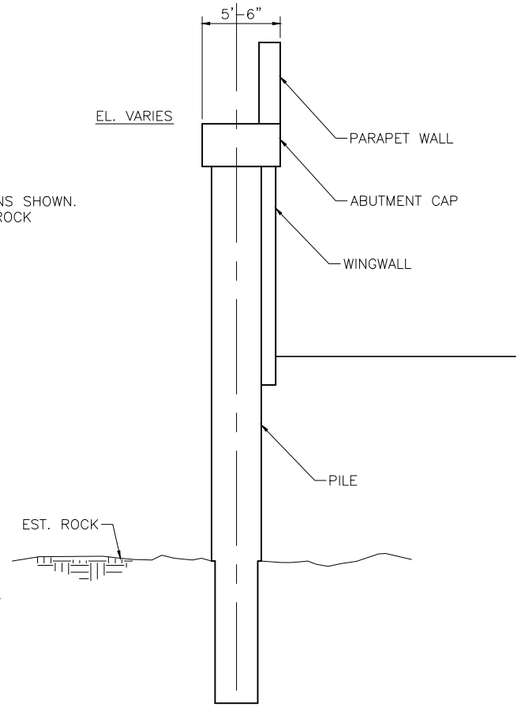
WEST ABUTMENT ELEVATION
SCALE: 1/16" = 1'–0"



EAST ABUTMENT ELEVATION
SCALE: 1/16" = 1'–0"

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN. SEE BORING LOGS FOR ROCK SURFACE VARIATIONS



WINGWALL SECTION
SCALE: 3/16" = 1'–0"

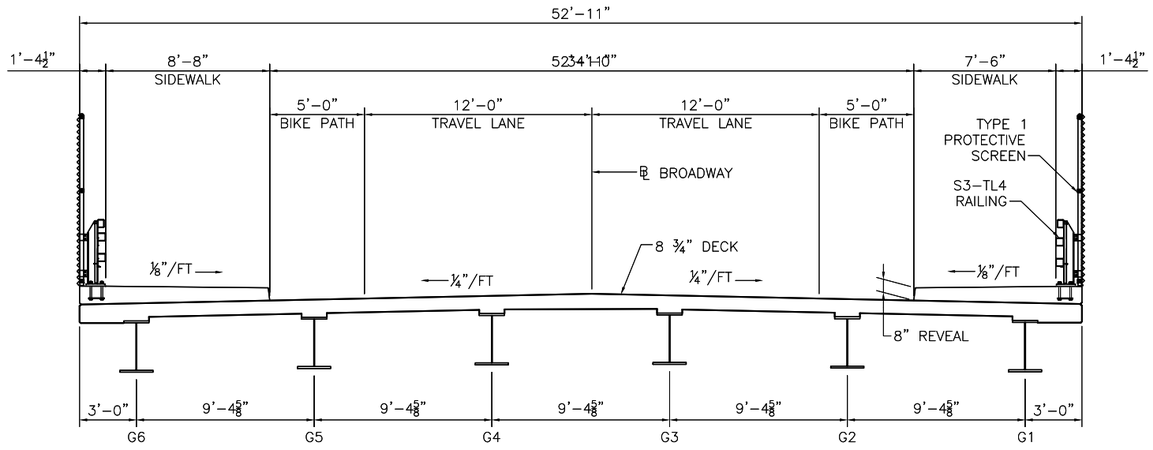
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

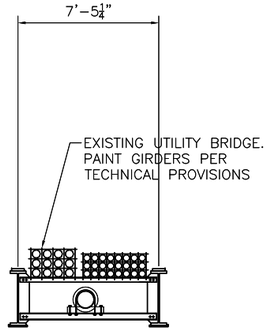
THE WALSH BARLETTA GRANITE
Joint Venture Team

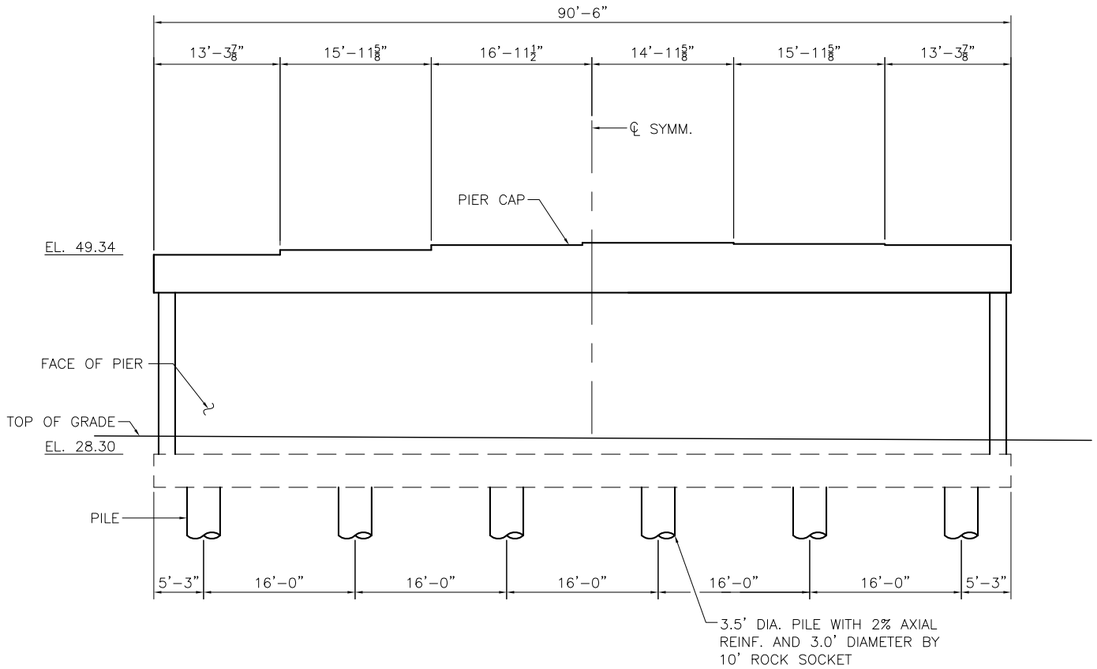
BROADWAY BRIDGE
ABUTMENT ELEVATIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET BRB-S-3001



TRANSVERSE SECTION
SCALE: 1/4" = 1'-0"

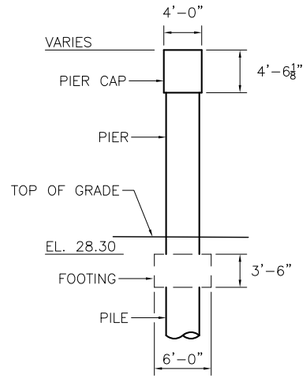




PIER ELEVATION
SCALE: 1/16" = 1'-0"

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN. SEE BORING LOGS FOR ROCK SURFACE VARIATIONS



PIER SECTION
SCALE: 1/16" = 1'-0"

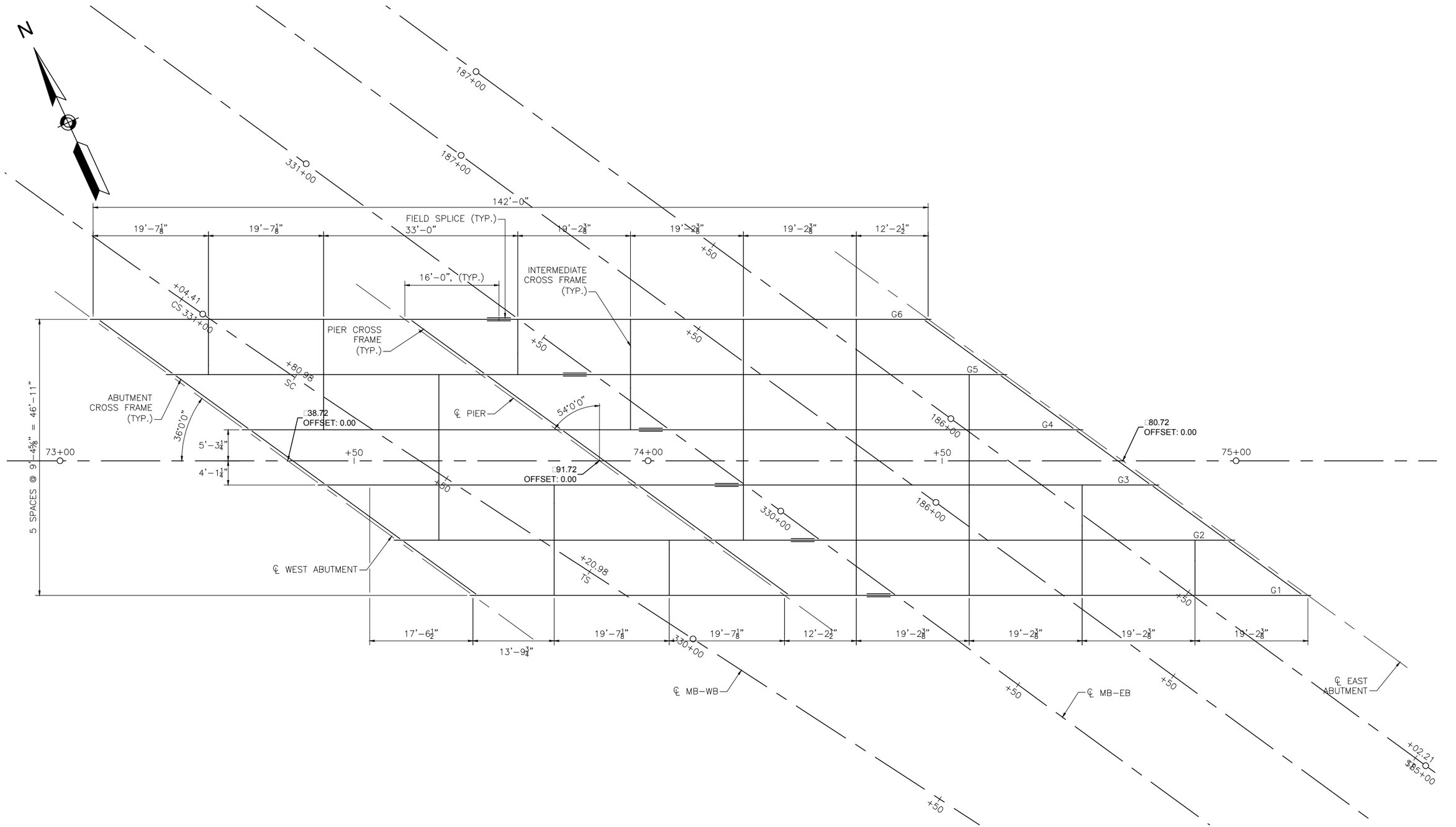
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

BROADWAY BRIDGE
TRANSVERSE SECTION AND PIER DETAILS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET BRB-S-4001



FRAMING PLAN
SCALE: 1/8" = 1'-0"

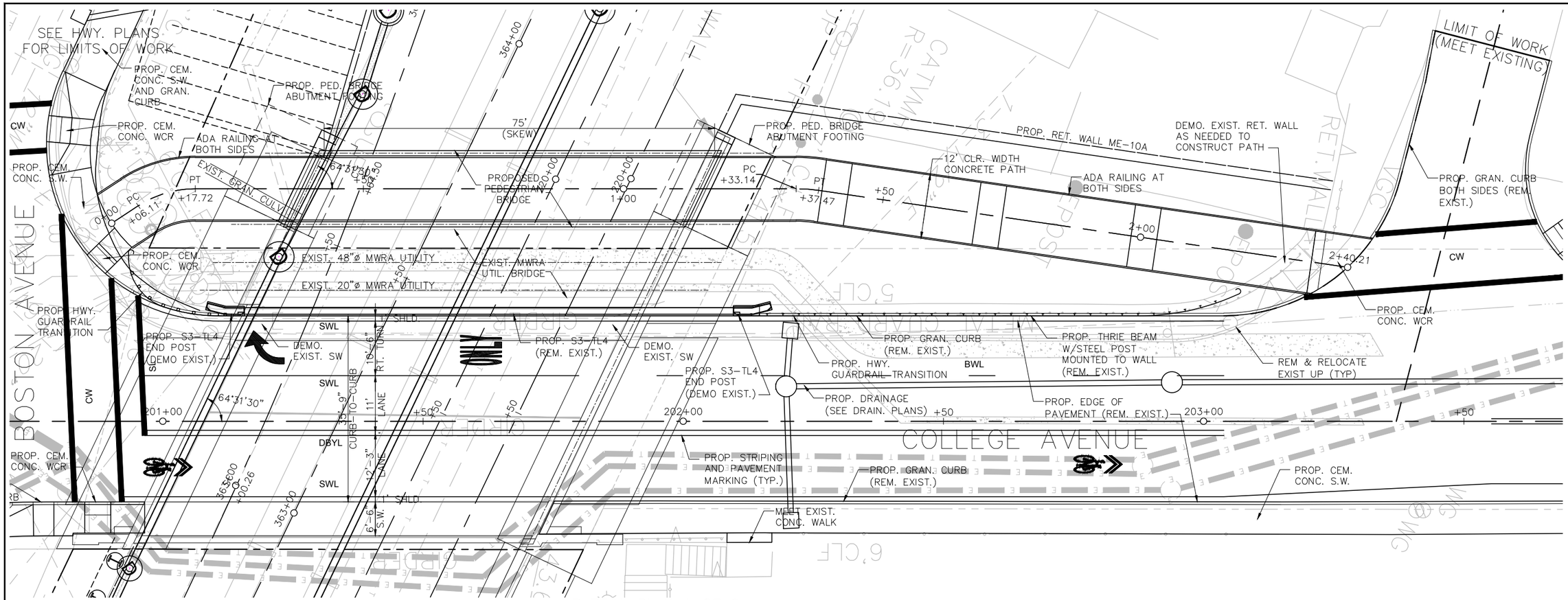
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

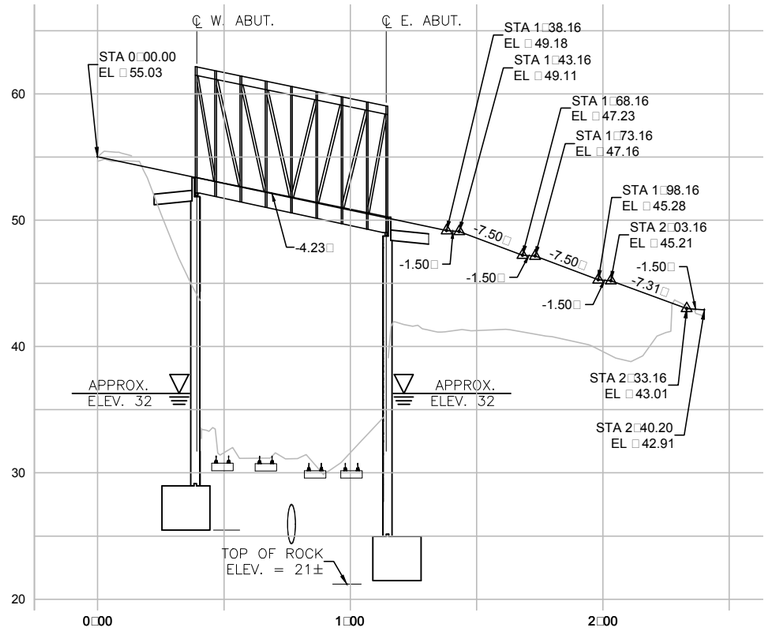
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

BROADWAY BRIDGE
FRAMING PLAN

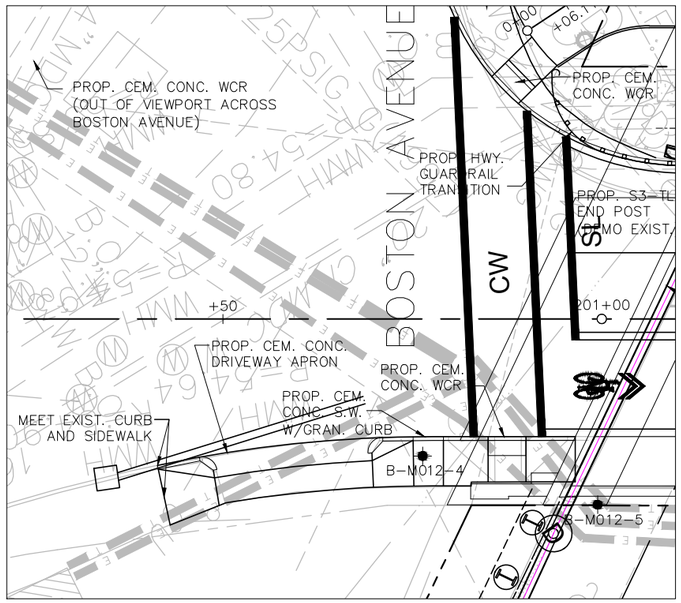
DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET BRB-S-5001



PARTIAL PLAN 1 OF 2
COLLEGE AVENUE OVER MBTA
SCALE: 1" = 10'



COLLEGE AVENUE PROFILE – ℄ PROPOSED PEDESTRIAN BRIDGE
HORIZ.: 1'=30' VERT.: 1'=6'



PARTIAL PLAN 2 OF 2
COLLEGE AVENUE OVER MBTA
SCALE: 1" = 10'

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

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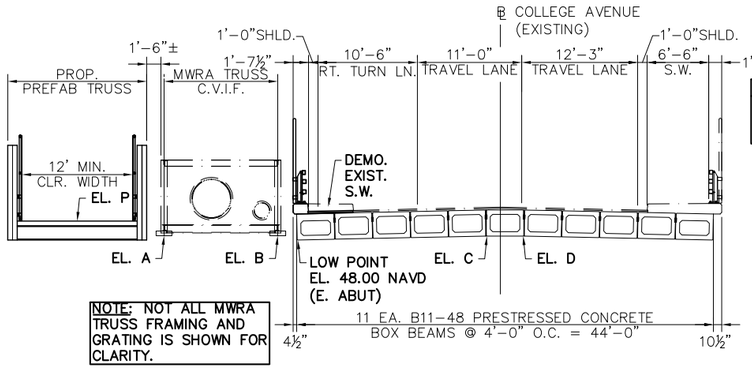
Joint Venture Team

COLLEGE AVENUE BRIDGE
BRIDGE PLAN & PROFILE

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET COB-S-2001



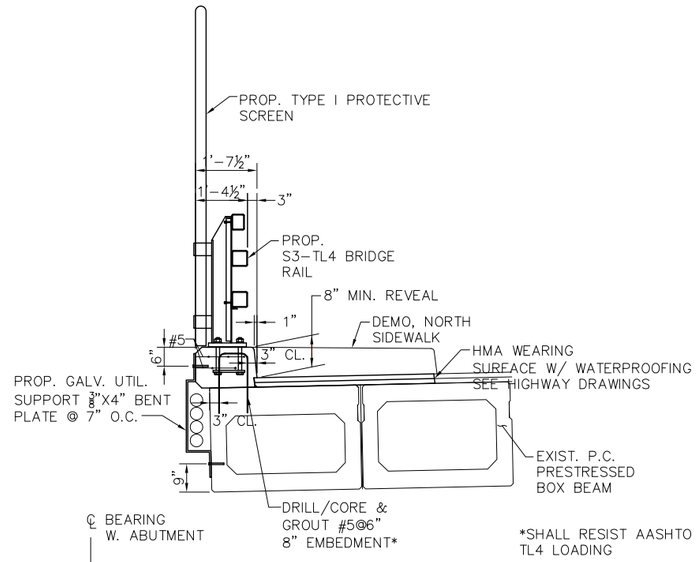
	EL. A	EL. B	EL. C	EL. D	EL. P
W. ABUT.	50.65	51.79	50.65	50.65	53.08
MID-SPAN	49.76	49.90	49.72	49.72	51.52
E. ABUT.	48.86	49.00	48.78	48.78	49.95

EXISTING ELEVATIONS (A–D) ARE PROVIDED IN N.A.V.D. 1988
TAKEN FROM REFERENCE PLANS USING N.G.V.D 1929
N.A.V.D. 1988 = N.G.V.D. 1929 – .807

NOTES:
1. PROVIDE INTEGRAL CONCRETE WEARING SURFACE
2. PROVIDE LIGHTING ALONG ENTIRE LENGTH OF APPROACH AND BRIDGE.
3. FOR LANDSCAPING SPECIFICATIONS REF. VOLUME 2 TECHNICAL PROVISIONS 7.5.3.7.
4. FOR HIGHWAY SPECIFICATIONS REF. VOLUME 2 TECHNICAL PROVISIONS 9.1.3.4.
5. PROVIDE ADA RAILINGS ALONG ENTIRE LENGTH OF APPROACHES AND ON BRIDGE.
6. BRIDGES AND APPROACHES SHALL COMPLY WITH ADA.

PROPOSED PEDESTRIAN AND COLLEGE AVENUE BRIDGE SECTION

SCALE: ¼" = 1'-0"



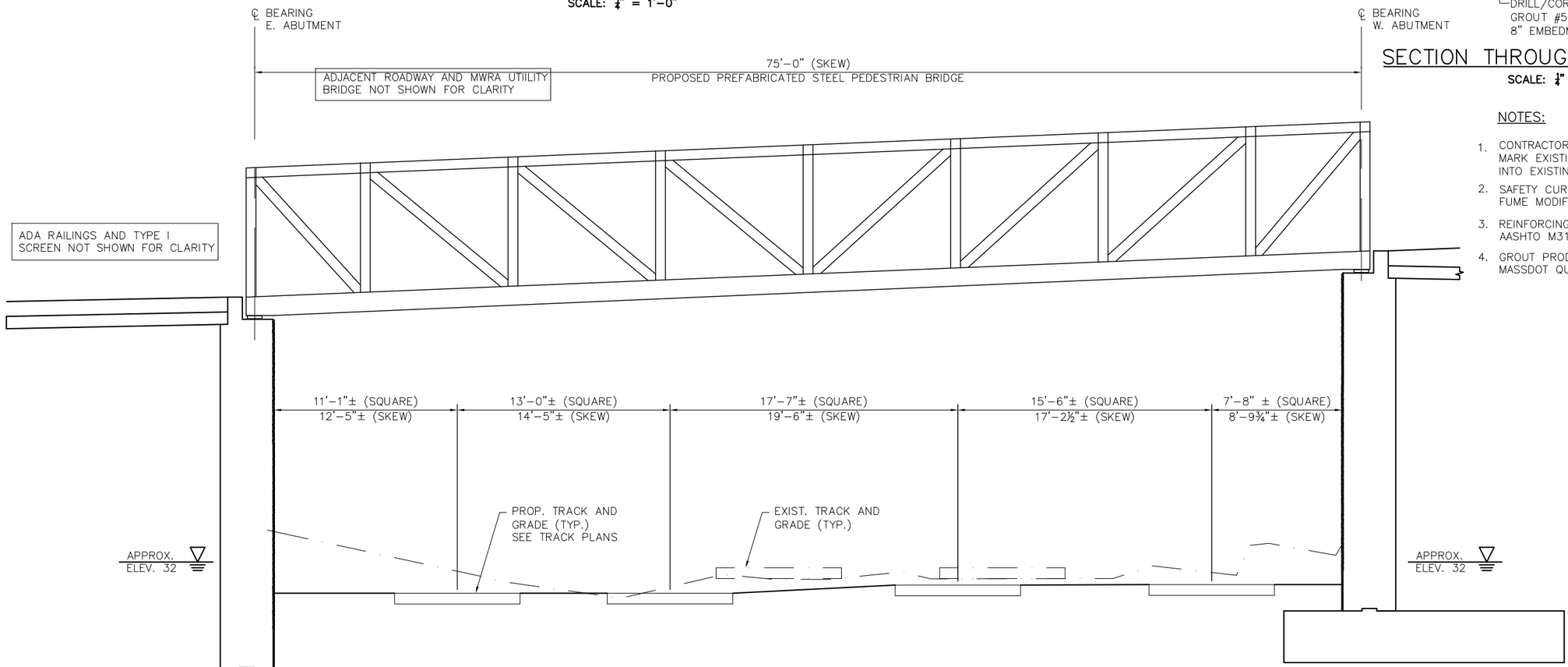
*SHALL RESIST AASHTO TL4 LOADING

SECTION THROUGH SAFETY CURB

SCALE: ¼" = 1'-0"

NOTES:

1. CONTRACTOR SHALL USE PACHOMETER TO LOCATE AND MARK EXISTING REINFORCING BEFORE DRILLING/CORING INTO EXISTING BEAMS.
2. SAFETY CURB CONCRETE SHALL BE 5000 PSI, ¾", SILICA FUME MODIFIED CEMENT CONCRETE.
3. REINFORCING SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M31 GRADE 60 AND SHALL BE EPOXY COATED.
4. GROUT PRODUCT SHALL BE LISTED ON THE CURRENT MASSDOT QUALIFIED CONSTRUCTION MATERIALS LIST.


℄ BEARING E. ABUTMENT
℄ BEARING W. ABUTMENT
ADJACENT ROADWAY AND MWRA UTILITY BRIDGE NOT SHOWN FOR CLARITY
75'-0" (SKEW)
PROPOSED PREFABRICATED STEEL PEDESTRIAN BRIDGE
ADA RAILINGS AND TYPE I SCREEN NOT SHOWN FOR CLARITY
11'-1"± (SQUARE)
12'-5"± (SKEW)
13'-0"± (SQUARE)
14'-5"± (SKEW)
17'-7"± (SQUARE)
19'-6"± (SKEW)
15'-6"± (SQUARE)
17'-2½"± (SKEW)
7'-8" ± (SQUARE)
8'-9¾"± (SKEW)
PROP. TRACK AND GRADE (TYP.) SEE TRACK PLANS
EXIST. TRACK AND GRADE (TYP.)
APPROX. ELEV. 32
APPROX. ELEV. 32
B.O.F. ELEV. 21.19 (E. ABUTMENT)
B.O.F. ELEV. 25.19 (W. ABUTMENT)
TOP OF ROCK APPROX. ELEV. 21 (B-M012-3)
PROP. 36" DRAIN ELEV. 24.45 INVERT (SEE DRAINAGE PLANS)
TOP OF ROCK APPROX. ELEV. 17 (B-M012-2)

PEDESTRIAN BRIDGE LONGITUDINAL SECTION

SCALE: ¼" = 1'-0"

4-70

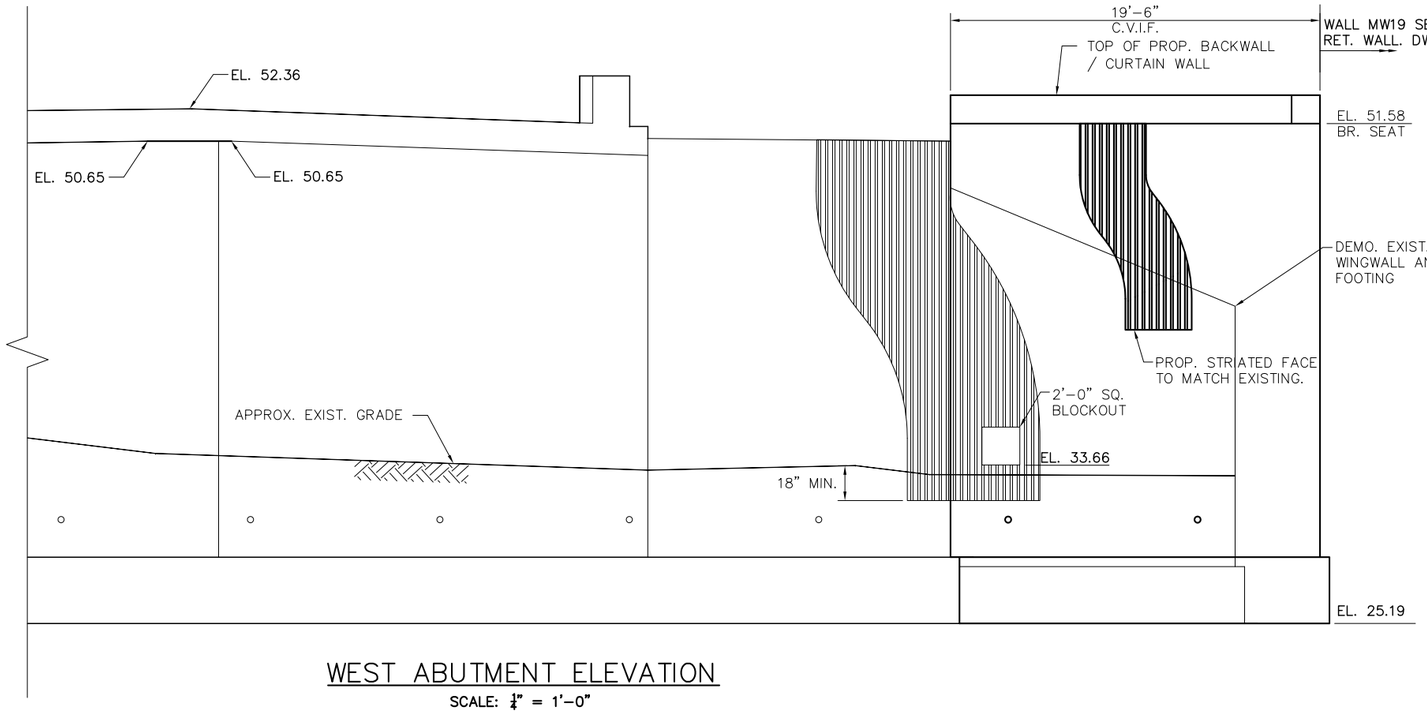
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

COLLEGE AVENUE BRIDGE
DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET COB-S-3001

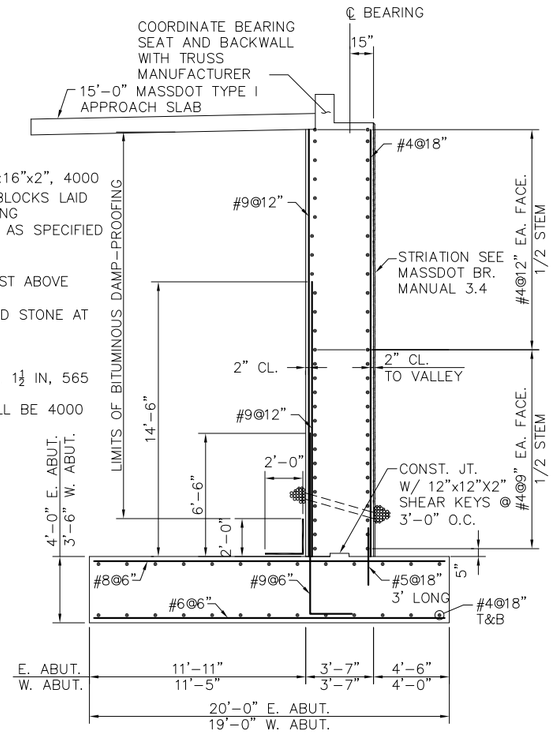


WEST ABUTMENT ELEVATION

SCALE: $\frac{1}{4}$" = 1'-0"

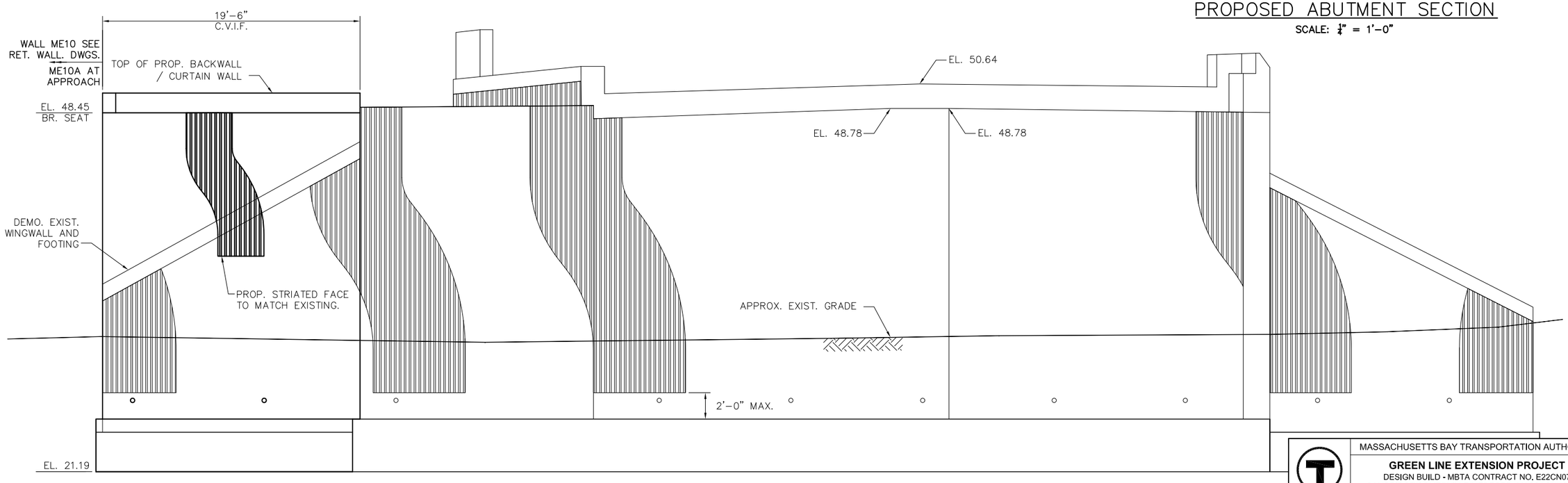
NOTES:

1. MEMBRANE WATERPROOFING AND 8"x16"x2", 4000 PSI, $\frac{3}{4}$ IN, 610 CEMENT CONCRETE BLOCKS LAID IN MORTAR OR OTHER WATERPROOFING PROTECTIVE COURSE, MIN. 2" THICK AS SPECIFIED IN MHD STANDARD SPECIFICATIONS.
2. 4" ø WEEP HOLES 10'-0" O.C. (JUST ABOVE PROTECTIVE COURSE). PROVIDE 1 CUBIC YARD OF CRUSHED STONE AT EACH END OF WEEP HOLE.
3. ALL CONCRETE SHALL BE 4000 PSI, $1\frac{1}{2}$ IN, 565 CEMENT CONCRETE EXCEPT THE BACKWALL, WHICH SHALL BE 4000 PSI, $\frac{3}{4}$ IN, 610 CEMENT CONCRETE.



PROPOSED ABUTMENT SECTION

SCALE: $\frac{1}{4}$" = 1'-0"



EAST ABUTMENT ELEVATION

SCALE: $\frac{1}{4}$" = 1'-0"

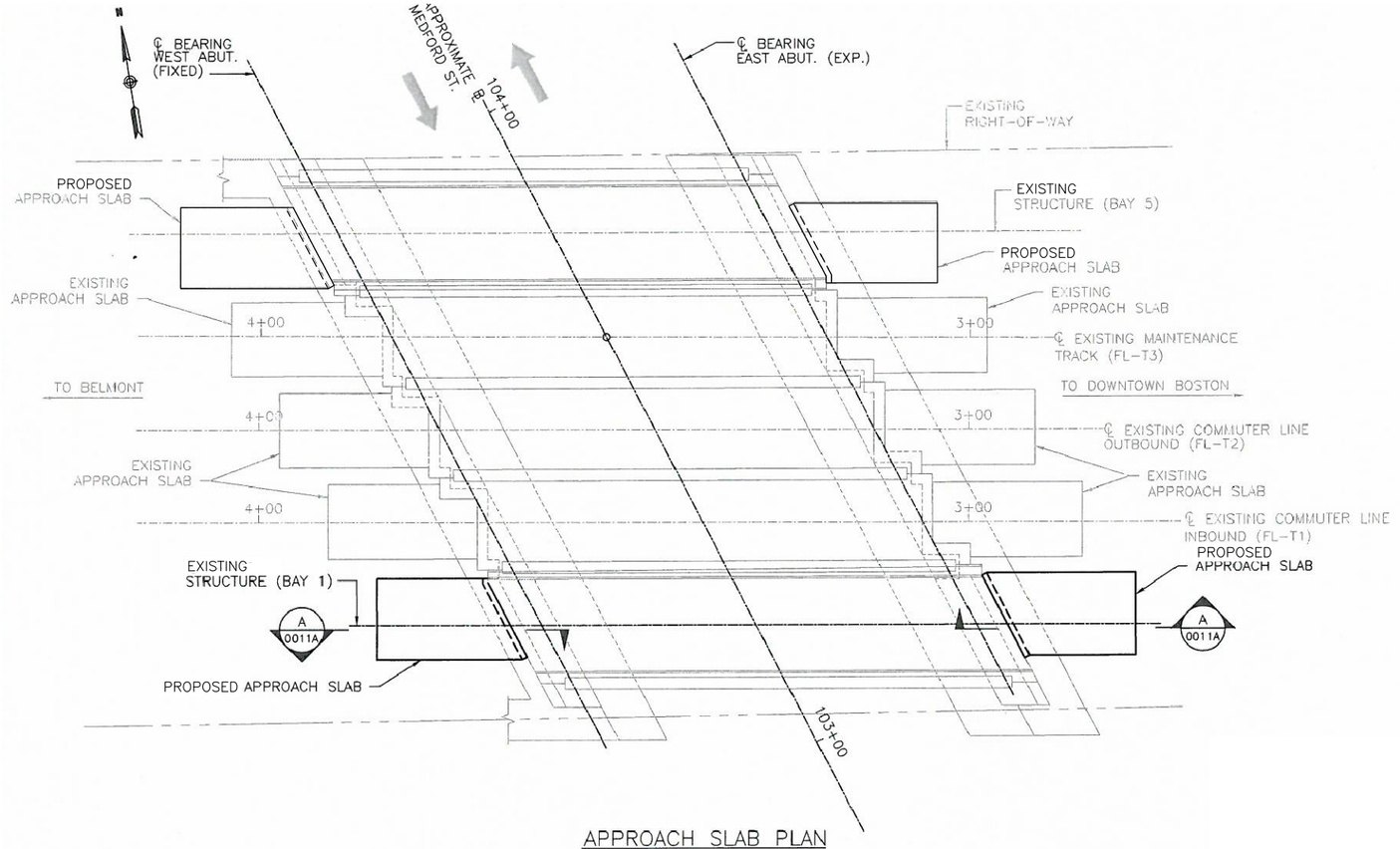
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

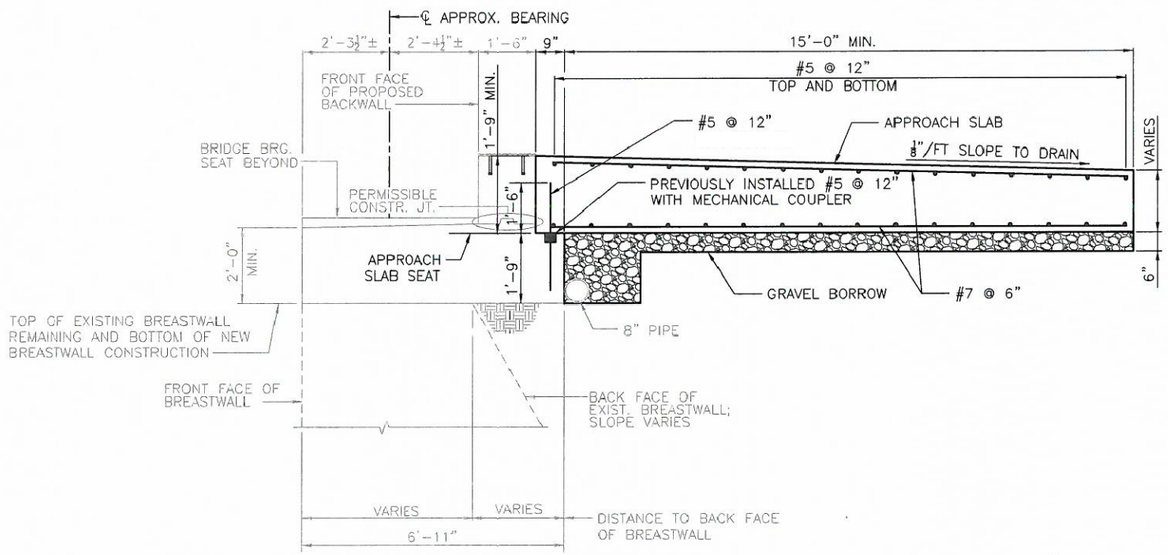
COLLEGE AVENUE BRIDGE
BRIDGE SECTIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET COB-S-8001



APPROACH SLAB PLAN

SCALE: $\frac{1}{32}$" = 1'-0"



TYPICAL APPROACH SLAB DETAIL – SECTION A–A

SCALE: ½" = 1'-0"

STRUCTURAL NOTES

CAST–IN–PLACE CONCRETE

ALL CAST–IN–PLACE CONCRETE SHALL BE IN ACCORDANCE WITH THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH (f'c) AND CONCRETE CLASS AT 28 DAYS:

f'c=4000 PSI, 1½" MAX. AGGREGATE FOR APPROACH SLABS.

CONCRETE MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

MINIMUM CONCRETE COVER SHALL BE AS SPECIFIED IN AREMA CHAPTER 8, TABLE 2–7, UNLESS OTHERWISE NOTED.

REINFORCING STEEL

REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM DESIGNATION A615, GRADE 60.

ALL SPLICES OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH AREMA CHAPTER 8, SEC. 2.22, UNLESS OTHERWISE NOTED. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

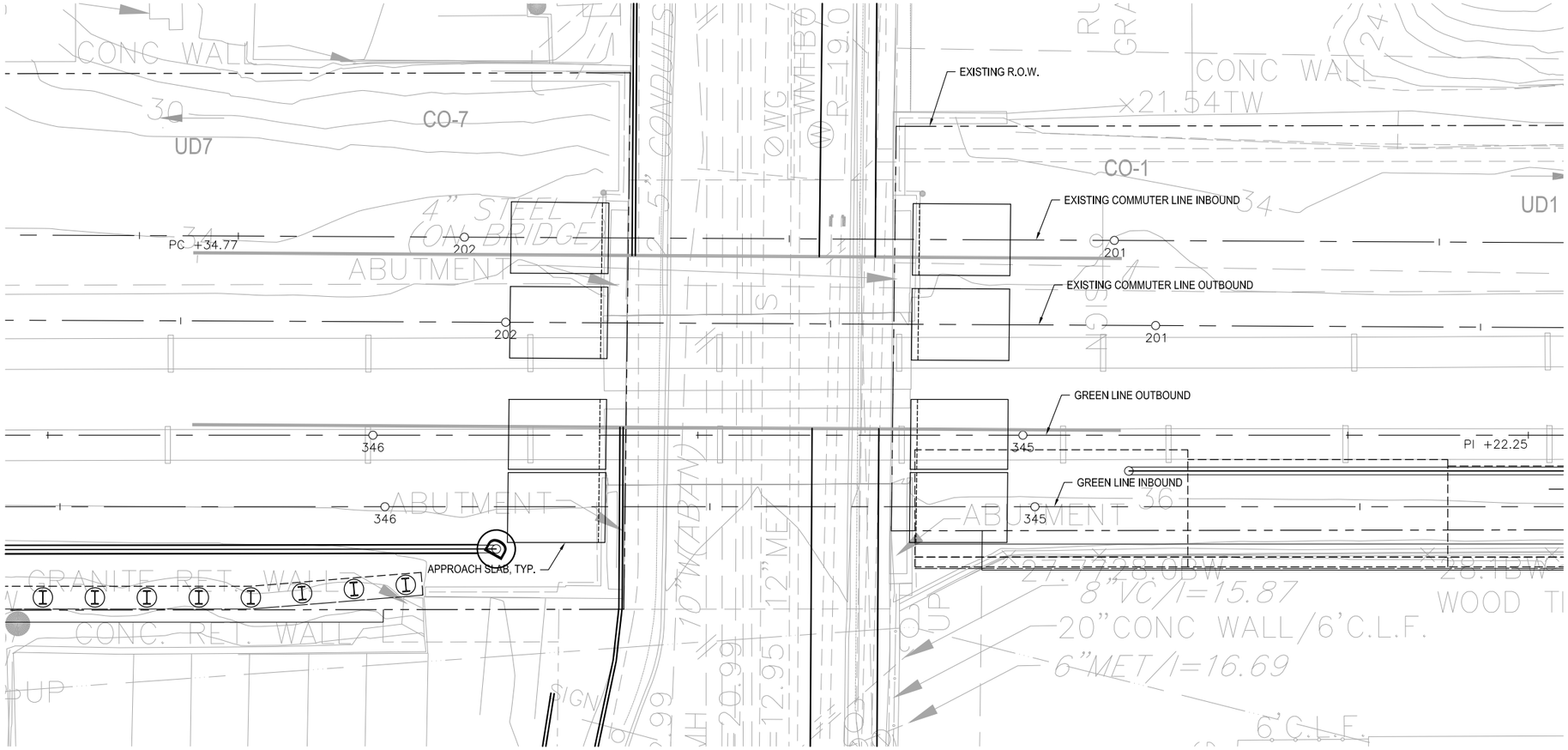
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

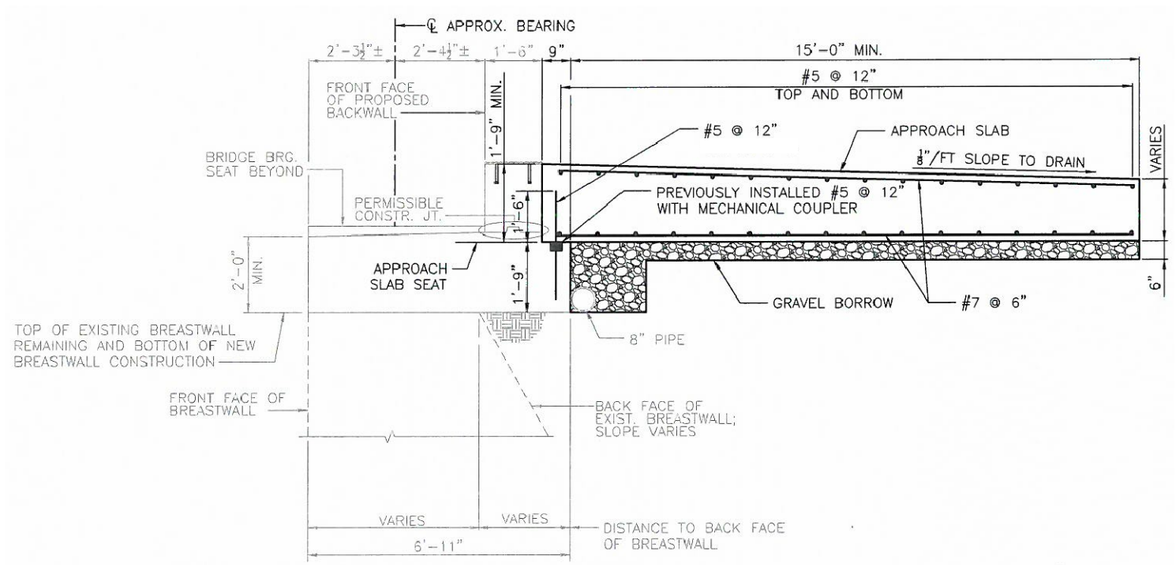
MEDFORD STREET RAILROAD BRIDGE
RAILROAD APPROACH SLAB

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MRB-S-2001



APPROACH PLAN

SCALE: 1" = 10'



TYPICAL APPROACH SLAB DETAIL – SECTION A–A

SCALE: ½" = 1'-0"

STRUCTURAL NOTES

CAST–IN–PLACE CONCRETE

ALL CAST–IN–PLACE CONCRETE SHALL BE IN ACCORDANCE WITH THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH (f'c) AND CONCRETE CLASS AT 28 DAYS:

f'c=4000 PSI, 1½" MAX. AGGREGATE FOR APPROACH SLABS.

CONCRETE MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

MINIMUM CONCRETE COVER SHALL BE AS SPECIFIED IN AREMA CHAPTER 8, TABLE 2–7, UNLESS OTHERWISE NOTED.

REINFORCING STEEL

REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM DESIGNATION A615, GRADE 60.

ALL SPLICES OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH AREMA CHAPTER 8, SEC. 2.22, UNLESS OTHERWISE NOTED. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

HARVARD STREET RAILROAD BRIDGE
RAILROAD APPROACH SLAB

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET HAB-S-2001

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STATIONS

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.3 Stations

WBG member firms have considerable MBTA experience in the design and construction of transit stations, with projects such as Fairmount Corridor Improvements, Worcester Commuter Rail Extension, Yawkey Commuter Rail Station, Light Rail Accessibility projects on the Blue, Green and Red Line, and System Wide Elevator Upgrades. Drawing from this experience, all seven of the new Green Line stations will emphasize functionality, accessibility, consistency, life safety, neighborhood integration, and ease of maintenance. The stations will be designed and constructed to accommodate potential future expansion beyond the Union Square and College Avenue stations.

A. ARCHITECTURAL REQUIREMENT

The goal of WBG's station design is to create a comfortable passenger experience and efficient technical layout for the station operators. The following narrative explains these design elements.

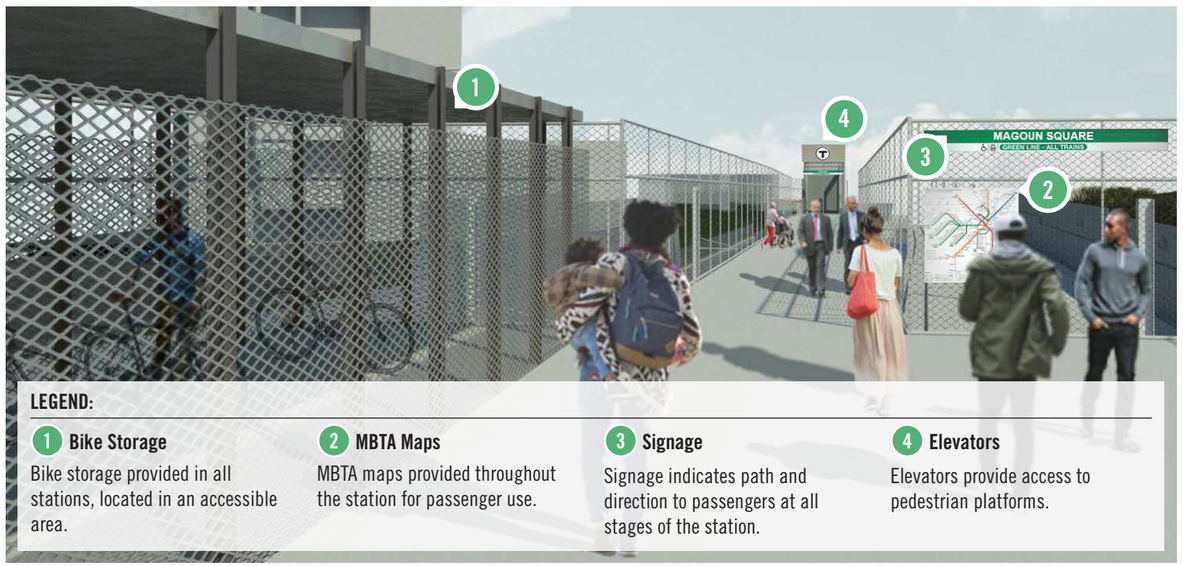
Accommodating Passenger Flows

Each station approach will be easily identifiable by using the MBTA logo "lollipop" signs. Routes to the station center platforms will be ADA accessible and will have an ADA-accessible path all along the platform and onto the train. The stations will have a clear entry, followed by an illuminated path with wayfinding signage. Signage will also be used to identify the main elements of the station such as bicycle storage, elevator, stairs, and fare vending machines.

During the design and construction process, WBG will coordinate with all relevant MBTA departments, such as Safety, Security, System-Wide Accessibility, Communications, Wayfinding, and Graphics. We will provide the Department of Public Safety construction progress updates via the MBTA. WBG will consider community feedback in the design.

Figure 4.3-1 shows the major elements that allow passengers to navigate the station with ease.

Figure 4.3-1 Passengers can easily navigate stations.


1
4
3
2
MAGOUN SQUARE
GREEN LINE - ALL TRAINS
LEGEND:
1 Bike Storage
Bike storage provided in all stations, located in an accessible area.
2 MBTA Maps
MBTA maps provided throughout the station for passenger use.
3 Signage
Signage indicates path and direction to passengers at all stages of the station.
4 Elevators
Elevators provide access to pedestrian platforms.

Crime Prevention Through Environmental Design

All stations are designed with the Crime Prevention Through Environmental Design (CPTED) approach in mind. Natural surveillance is a key part of the CPTED; it is created through consideration of the placement of physical features, activities, and flow of people in such a way that maximizes user visibility. This fosters positive and safe social interaction among users of all spaces within and around the stations.

The platforms at each station, with the exception of the elevated viaduct station at Lechmere, are slightly lower than the level of the surrounding streets. The difference in height creates a direct view from the streets to the platforms, allowing for natural surveillance to occur. Potential offenders feel increased scrutiny through natural surveillance, and thus perceive an increase in risk. All stations are designed to minimize the number of blind spots and potential hiding areas, and all platform shelters will be transparent. Station entries will be located in an area visible from the public way in a well-traveled area to maximize natural surveillance. The landscape design will not obstruct main user sight lines, especially at station entry and exit points. The elevators will use glass to create visibility from the interior of the elevator to the platform at all times.

The lighting design will create a uniform lighting strategy throughout the station and platform in order to avoid blind spots and potentially dark areas. The fare collection machine area and other secluded areas will be especially well lit. Lighting will be provided with enough intensity to illuminate all areas, but dim enough to prevent blinding glare and/or deep shadows that would hinder the users' view. Lighting will be provided along pathways and other pedestrian-use areas at appropriate heights to ensure that users' faces will be illuminated at all hours of the day.

In addition to the CPTED technique of natural surveillance, emergency call boxes and closed circuit television cameras will be located throughout the stations.

Full Accessibility

The station design focuses on providing a fully accessible experience for all passengers. To create this experience, station entries will be accessible from a public way with a minimum of one accessible route to the platform (Figure 4.3-2). All walkways will be at least 8 feet wide and permit the customer to navigate to and from the platform in the most direct route possible with a clear line of site to changes in vertical direction. All elevators will comply with the requirements of the Boston Center for Independent Living (BCIL).

Figure 4.3-2 Full Accessibility. Each station will have a minimum of one accessible route to the platform. Additionally, WBG will use BCIL-compliant elevators, such as the one shown below, to improve accessibility.

LECHMERE STATION
Walkways from East and North First Streets, Route 28, and bus loop; Utilizing **stairs and elevators** to elevated platform

EAST SOMERVILLE STATION
Community Path from Washington Street
Utilizing **sloped walkways** to the platform

GILMAN SQUARE STATION
Elevated entry from Medford Street
Utilizing an **elevator and stairs** to the platform

MAGOUN SQUARE STATION
Elevated entry from Lowell Street
Utilizing an **elevator and stairs** to the platform

BALL SQUARE STATION
Boston Avenue to platform
Utilizing **at-grade walkways**

COLLEGE AVENUE STATION
Elevated entrance from plaza on Boston Avenue
Utilizing an **elevator and stairs** to the platform

UNION SQUARE STATION
Bennett Court to platform
Utilizing **sloped walkways** to the platform

Yawkey Station Improvements Design-Build, Boston. Walsh led this project constructing a new headhouse to provide vertical access to the station from the street utilizing stairs and four elevators.

All stations will be compliant with ADA Standards. Compliance will be achieved through designing the platform to create accessible entry onto all MBTA trains. Platforms will be a minimum of 20 feet wide, and provide a minimum clearance of 6 feet from platform edge to any obstruction such as columns, shelters, and other amenities, as well as providing accessible fare vending machines and including yellow tactile warning panels along the edge of the platform. The stations will have the flexibility to include bilingual wayfinding in order to address Title VI of the Civil Rights Act. Platforms include two means of egress, which will include emergency egress routes that will either be fully accessible or provide an area of refuge at least 50 feet away from the platform area and enclosed with fencing. All pedestrian paths that cross the tracks will include rubber crossings.

Customer Experience

Customer experience is an important and key component of the GLX Project. The customer experience begins before a user even enters the station. All stations will be visible from the public way by utilizing MBTA logo "lollipop" signs, and will have clear signage indicating the entrance and location of the platform. Once entering the station, the path to the platform will be well lit and include proper signage to indicate the direction of exits and the platform. The platform will provide seating and shelter, in addition to proper illumination and wayfinding.

To ensure that passengers have a pleasant and successful experience, clear and consistent signage will indicate the nearest exit, train destination for each side of the platform, customer assistance area, communication devices, call boxes, variable message signs (VMS), and closed circuit television cameras.

To maintain the cleanliness of the stations, as well as the user experience over time, the stations will include vandal-proof design strategies. This includes graffiti mitigation, implementing a bird repellent system, and avoiding creating spaces that could potentially enable homeless staging. The finishes and elements of the station will be selected with durability and maintainability in mind, as well as ease of replacement. The design of the stations also will take into account the need for winter resiliency through snow removal and de-icing, the location of trash receptacles, and the ability for the platform to be vertically relocated 6 inches to accommodate level boarding into the future Type 9 vehicles.

Visual Continuity

The stations will be clearly marked at the public way to ensure it is identifiable by all users as an MBTA station. GLX will follow the MBTA Manual of Guidelines and Standards in order to ensure that all stations are clearly identifiable as part of the MBTA system. Every station will be designed to blend into the aesthetics of each neighborhood as much as possible.

Interfaces

All station entries will be situated in a clearly visible point of the public way that is accessible from a major public way of the surrounding area. Intersection improvements, such as the addition of wheelchair ramps, bicycle pavement markings, and signage, will promote a seamless interface between public areas and station entry points. At Gilman Station, the Community Path will be a key point to ensure that the Green Line is well integrated with the surrounding infrastructure and neighborhood.

Shelter Design

Materials, Finishes, Envelope, and Weather Protection

The main purpose of the shelter is to protect passengers from natural elements. The shelter will be constructed out of weather-resistant materials, such as tempered glass and galvanized aluminum.

Number and Size of Shelters

Shelters will be provided to accommodate average peak hour, per-vehicle passenger volume projected for that station. The number of shelters will account for approximately 3.5 square feet per person. There will be at least three shelters at each station, with a 6-foot by 8-foot minimum dimension, in accordance with MBTA guidelines. Shelters will accommodate two wheelchair areas, seating for at least two customers, and lighting for customer convenience and safety.

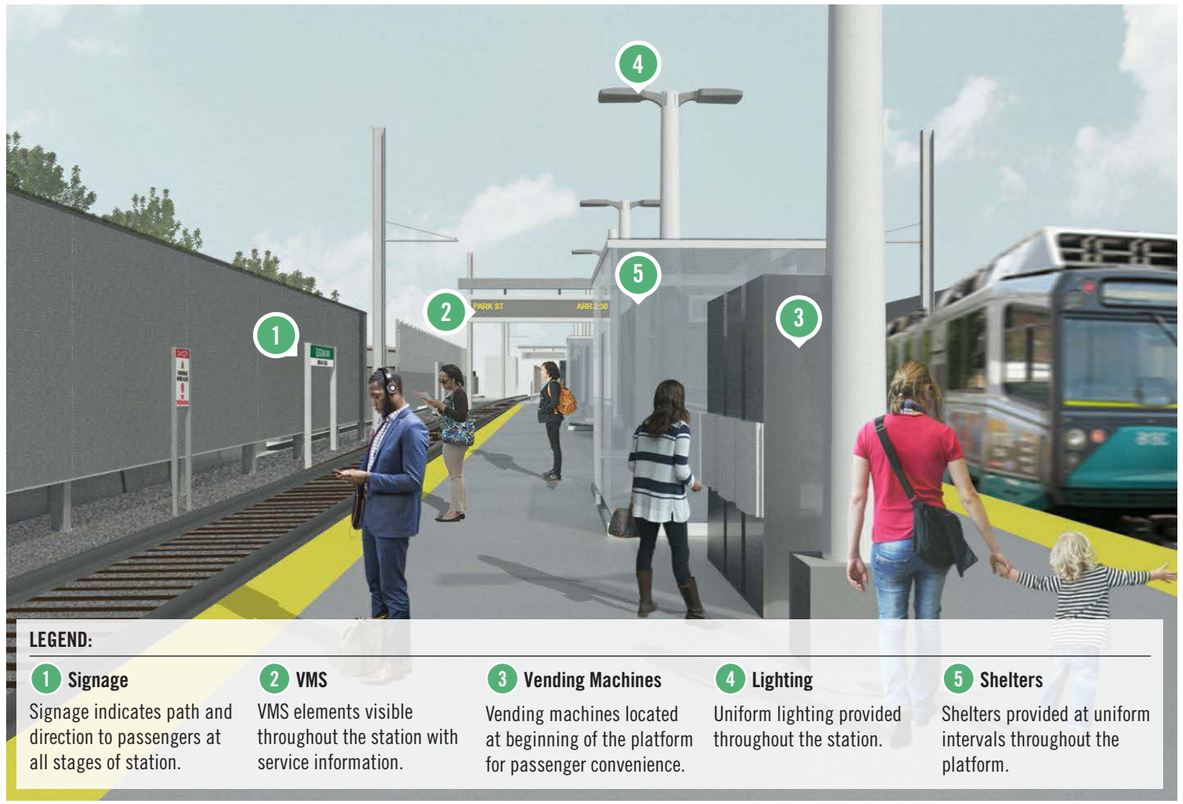
Organization of Required Platform Equipment and Elements

The stations will be organized with all passengers in mind. The signage and primary needs, such as bicycle storage, will be at the station entrance. Within the platform, equipment will be organized in order of necessity to the user. For example, the fare vending machines will be situated at the entry of the platform. Shelters and benches will be provided at a set distance no more than 200 feet from one to the other, with an emphasis on placing benches in close proximity to waiting areas. Trash receptacles will be located near station entrances and shelters and clear from the path of travel. Stations will also include passenger assistance units that will be located along the platforms, walkways, and in the Customer Assistance Area. (Figure 4.3-3).

B. ARCHITECTURAL DRAWINGS

WBG has provided site plans with information on platform equipment with the Composite Drawings. Included is a site plan for every station with 3D views and typical details for all elements present in drawings.

Figure 4.3-3 Organization of Required Platform Equipment and Elements.



LANDSCAPING AND STATION SIGNAGE DESIGN

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.4 Landscaping and Station Signage Design

Communication with the MBTA's Wayfinding and Graphics departments is essential to a successful signage package. The MBTA emphasizes coordination with their departments in order to ensure system-wide consistency. WBG will pay special attention to ensure code compliant slopes, as well as positive drainage at landscaped plazas. The landscape and signage materials, chosen for their durability and performance, will be integrated into a cohesive design vision that reflects a commitment to context, quality, and longevity.

A. LANDSCAPE ARCHITECTURE

The GLX Project's landscape architectural component contributes to the public's ease of use and pleasurable experience of this transit project. Each station will be integrated into its urban context, like the Cambridge Center Plaza in Figure 4.4-1 designed by WBG's Landscape Architect, Shadley Associates, P.C. (Shadley). Shadley is a Massachusetts-based DBE firm that has significant experience designing landscapes for urban areas throughout New England.

Conformance to Landscape Requirements

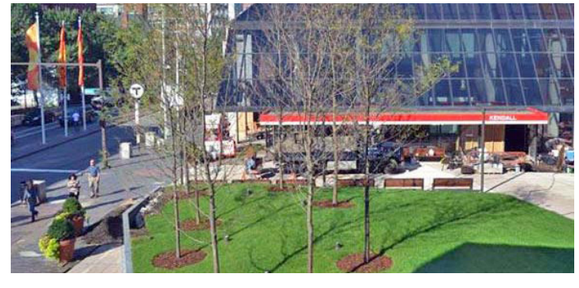
The landscape architectural components, composed of the protection of existing vegetation, creation of new planted areas for slope stabilization, visual buffers and drainage control, and new public plazas with site amenities, will integrate transit improvements into their context. We will design and construct landscape improvements that use native plants and sound planting and maintenance practices, anticipate climate change, utilize the principles of Crime Prevention through Environmental Design, and are safe and comfortable.

Site-Specific Landscaping Requirements

Stations: Each station will be designed to fit within its context. This includes clear, ADA-compliant and safe pedestrian connections; low-maintenance, attractive, and comfortable plazas where appropriate; artwork where possible; and plant material that encourages visibility and easy maintenance, and provides shade, habitat, and visual appeal based on sound horticultural practices. Landscape plans will incorporate stormwater water quality and detention goals. In addition, station design will anticipate and support adjacent private Transit-Oriented-Development, including honoring MBTA agreements with these developers. Each of the seven light-rail stations has specific landscaping goals, as described in Figure 4.4-2.

Vehicle Maintenance Facility (VMF): The landscape improvements at the VMF will include the appropriate depth of landscape medium for the proposed shade trees at 3-inch to 3.5-inch caliper, shrubs, and perennials, which will soften and buffer this facility and its parking area. Plant materials near parking areas will be selected for salt-tolerance, and snow stockpile areas will be considered as well.

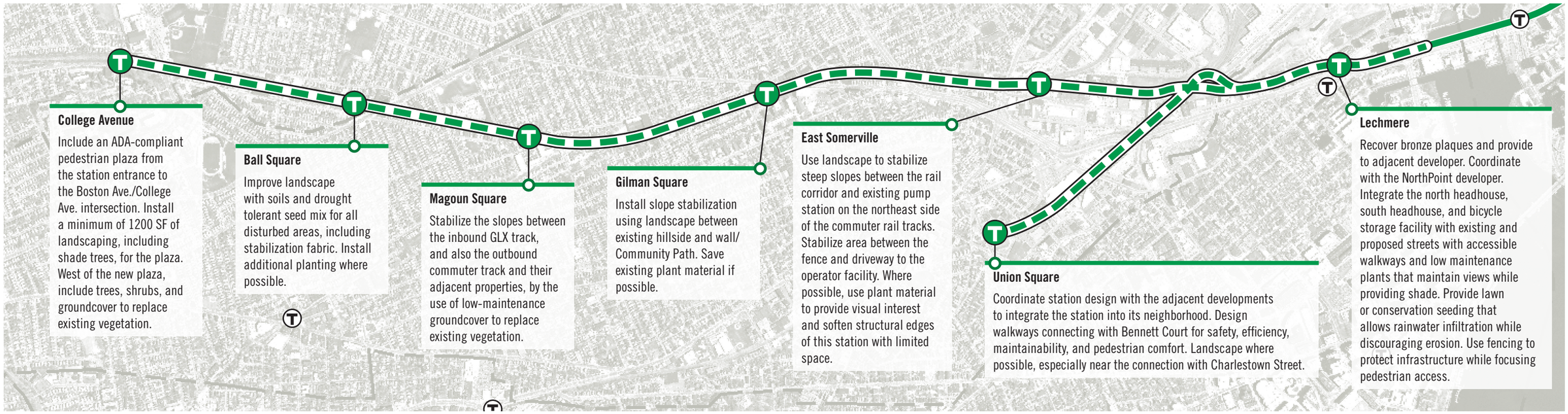
Figure 4.4-1 Cambridge Center Plaza adjacent to the MBTA's Kendall Square Light Rail Station. Trees at station entrances will be selected based on their planting environment and functional goals. (Landscaping design by Shadley)



Traction Power Substations: The landscape at the traction power substations will be designed to maximize visibility for security cameras, while also providing visual buffers where appropriate.

Transit Corridor: The landscape plans will preserve and protect existing vegetation on private abutting property, and within the transit corridor wherever possible. A tree/vegetation survey will be performed, which will be used for the tree protection and maintenance program implemented before construction begins.

Figure 4.4-2 Landscaping Goals for the Seven Light Rail Stations.


College Avenue
Include an ADA-compliant pedestrian plaza from the station entrance to the Boston Ave./College Ave. intersection. Install a minimum of 1200 SF of landscaping, including shade trees, for the plaza. West of the new plaza, include trees, shrubs, and groundcover to replace existing vegetation.
Ball Square
Improve landscape with soils and drought tolerant seed mix for all disturbed areas, including stabilization fabric. Install additional planting where possible.
Magoun Square
Stabilize the slopes between the inbound GLX track, and also the outbound commuter track and their adjacent properties, by the use of low-maintenance groundcover to replace existing vegetation.
Gilman Square
Install slope stabilization using landscape between existing hillside and wall/ Community Path. Save existing plant material if possible.
East Somerville
Use landscape to stabilize steep slopes between the rail corridor and existing pump station on the northeast side of the commuter rail tracks. Stabilize area between the fence and driveway to the operator facility. Where possible, use plant material to provide visual interest and soften structural edges of this station with limited space.
Union Square
Coordinate station design with the adjacent developments to integrate the station into its neighborhood. Design walkways connecting with Bennett Court for safety, efficiency, maintainability, and pedestrian comfort. Landscape where possible, especially near the connection with Charlestown Street.
Lechmere
Recover bronze plaques and provide to adjacent developer. Coordinate with the NorthPoint developer. Integrate the north headhouse, south headhouse, and bicycle storage facility with existing and proposed streets with accessible walkways and low maintenance plants that maintain views while providing shade. Provide lawn or conservation seeding that allows rainwater infiltration while discouraging erosion. Use fencing to protect infrastructure while focusing pedestrian access.

Community Path: Landscaping along the Community Path (Figure 4.4-4) will include landscaped edges to minimize erosion by installing seeding, planting, and erosion control geotextiles where appropriate. Plantings will be used to provide buffer screening, while maintaining visibility for safety, providing shade, and adding visual and seasonal interest. Benches will be added at appropriate locations to encourage community use.

Planting Criteria

WBG will prepare an overall plant list for deciduous, ornamental and evergreen trees, deciduous and evergreen shrubs, and groundcover in a matrix form with essential criteria. Criteria will include each plant's native status, drought tolerance, salt tolerance, tolerance of heat and water, USDA zones (5 is required), and mature plant characteristics such as height, width, flower, bark, fall color, and maintenance requirements. Each plant needs to thrive without irrigation and fertilizer after the establishment period. The plants for each station or location will be selected from this list, using sound design principles for specific sites such as solar orientation, wind, and slopes, as well as proximity to fences, wall, or pedestrian paths, and aesthetic goals.

During the installation and maintenance period, all landscaped areas will be monitored to prevent the establishment of invasive species. New plants will be monitored for possible weeds in their rootballs, finish grading work will include removing all weed growth, and installation of seed mixes will be monitored. During establishment, all landscape areas will be reviewed and inspected, and any invasive species will be removed.

Site Amenities and Furnishings

Site amenities, such as bike racks (shown in Figure 4.4-3), benches, and trash receptacles, plus other site elements in the public realm (including lighting, signage, security cameras and bicycle parking), will be integrated within each station's site design (Figure 4.4-5). Our general approach is to make amenities consistent throughout the entire GLX Project so that the MBTA may maintain them easily. However, there may be reasons at specific locations to differ from this approach to integrate the location with its neighborhood context. All site furnishings shall conform to MBTA Design Standards.

Third Party Agreement Requirements

Third party agreements will be cataloged, understood, and honored in the landscape plans. These agreements are critical to the success of this project, both for the MBTA and for the private parties who are anticipating the GLX Project in their developments. Examples of third party requirements that will be adhered to include tree protection and areas that must be restored to their original condition.

Landscape Drawings

Landscape drawings are included with the Composite Drawings that demonstrate the following:

- Integration of the system into the surrounding urban context
- Identification of pedestrian and cycling connections
- Consistency of a system-wide streetscape
- Accessibility

Renderings

Renderings are included with the Composite Drawings that illustrate typical grading, materials, site amenities and furnishings, including lighting, bicycle racks, signage, plant material, and other elements to demonstrate compliance with the Technical Provisions.

Figure 4.4-4 Community Path Landscaping Plan.

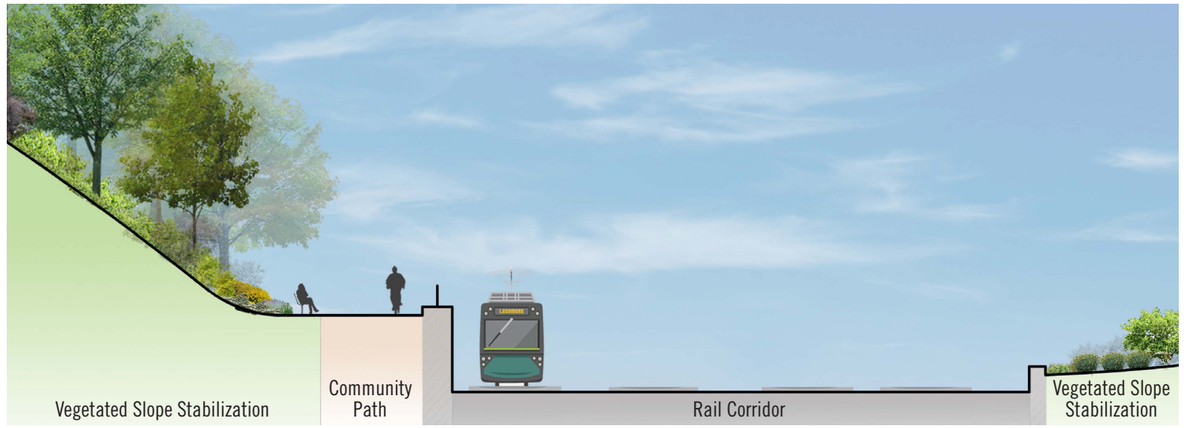


Figure 4.4-5 Landscaping along the GLX College Avenue Station. Trees, native shrubs, groundcover, and benches add a welcoming entry to the College Avenue Station.

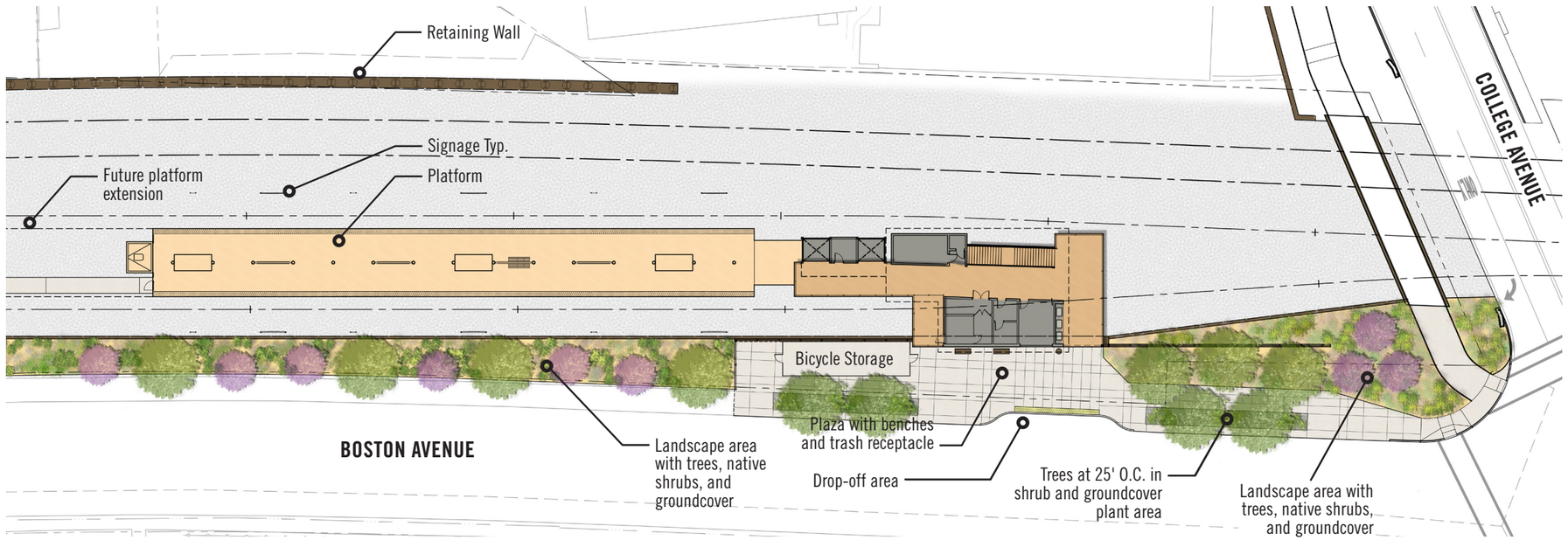

Retaining Wall
Signage Typ.
Future platform extension
Platform
COLLEGE AVENUE
Bicycle Storage
Plaza with benches and trash receptacle
BOSTON AVENUE
Landscape area with trees, native shrubs, and groundcover
Drop-off area
Trees at 25' O.C. in shrub and groundcover plant area
Landscape area with trees, native shrubs, and groundcover

Figure 4.4-3 Station Amenities. Bicycle cage at Malden Center Station on the Orange Line, as designed by Jacobs.

B. WAYFINDING, SIGNAGE, AND VISUAL DISPLAY

Visual Elements Strategy

Signage and Common Elements

Our approach to placement and system integration of signage and common elements throughout the GLX Project relies on close coordination with the MBTA Wayfinding and Graphics departments. We will work with the MBTA to incorporate the common graphic standards and symbols used for wayfinding throughout MBTA projects. This will create continuity and easy recognition of the MBTA throughout all stations on the Green Line Extension. Signage will be placed at locations that are most visible and accessible to all riders, and will clearly direct, warn, and inform riders through common graphics.

To create further clarity, wayfinding elements will have unobstructed sight lines and be well-lit by a uniform lighting strategy (Figure 4.4-7). The lighting strategy will be visually comfortable for riders, meaning proper illumination during dark hours and no glare on signage or wayfinding elements.

Figure 4.4-7 Lighting Strategy. WBG's design will include a uniform lighting strategy that provides well-lit signage and wayfinding elements.

Government Center Green Line Station
Constructed by Barletta

Charles/MGH Red Line Station
Constructed by Barletta

Intuitive Wayfinding

To provide intuitive wayfinding, we will use clear and consistent graphics (such as colors, text, and symbols) across the seven stations and the Lechmere bus loop along the GLX corridor. Each station entry will provide wayfinding that is clearly visible in point of the public way. As a critical decision making point, station entries will provide wayfinding that clearly identifies all route options to riders. The wayfinding will direct riders throughout the station and identify accessible routes, nearest exit, and destination of the train on each side of the platform.

Wayfinding Routing

All stations will be designed with equal use and accessibility in mind for all riders. All accessible routes of travel will be integral with the primary route for the general public. There will be directly accessible pathways from public sidewalks and transit stops to the accessible entrance. The accessible routes will be clearly identified through wayfinding elements at all critical decision making points leading up to and within the stations (Figure 4.4-6).

Visual Elements Drawings

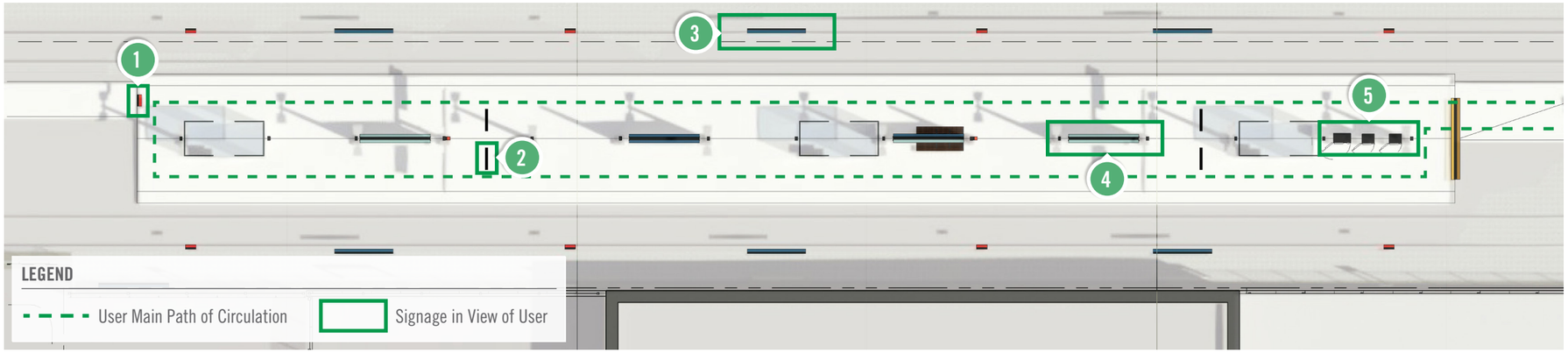
Drawings are provided with the Composite Drawings that demonstrate the following, per the Instructions to Proposers:

- Station site plans showing typical wayfinding routing with sign placement and wayfinding routes, including accessible and non-accessible routes
- Signage plans showing static and variable messaging signs, including station identification signs and markers, regulatory signs, code-required signs, informational signs, system-wide signs, and signs related to the art program, such as plaques.

Renderings

Typical renderings for key points are provided with the Composite Drawings.

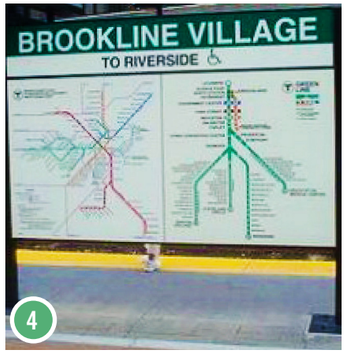
Figure 4.4-6 Typical Wayfinding Routing. Critical visual elements on a typical GLX station platform.



Regulatory/Warning Signage
Emergency Egress sign

Variable Message Sign
Schedule information

Track Signage
Station Identification and Wayfinding signs



Platform Maps
Rapid Transit Line Map and Green Line Map signs

Visual Elements
Fare Collection signs and equipment

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VEHICLE MAINTENANCE FACILITY

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.5 Vehicle Maintenance Facility

Both the Vehicle Maintenance and Transportation Buildings will be designed and built to create a facility that is durable and efficient. WBG has thoroughly planned all aspects of the facility so that the MBTA will have a safe and reliable facility to store, operate, and maintain the GLX fleet. Combining our full understanding of MBTA operations with our shop and yard experience will allow WBG to deliver a compliant and functional facility.

A. ARCHITECTURAL DESIGN

Meeting Architectural Requirements

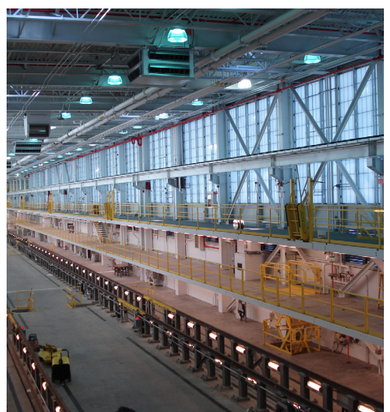
WBG conducted a thorough review of the Vehicle Maintenance Building (VMB). Our design development process has allowed us to confirm code compliance, design building systems, and minimize construction costs, all while enhancing the overall building design. Six new mechanical and electrical equipment rooms were added to the design. Several new doors were also added for emergency egress and equipment room access. These refinements will benefit MBTA personnel working in the building and demonstrate WBG's in-depth understanding of shop operations. Ample heating and ventilation have been provided in the design to ensure worker comfort, and extensive areas of translucent panels are provided on the modern building facade.

The six new rooms were added on a newly designed mezzanine (Figure 4.5-1). This addition eliminated the need to grow the building's footprint, which would have impacted the already sharp curves in the yard track alignment. These rooms are located above the office area and connected by a stairway. Although not ADA accessible, these infrequently used rooms will need to be serviced by able-bodied workers, similar to the main pit area. Removable railings will allow forklift access to this floor for transporting heavier items.

The following detailed discussion demonstrates WBG's complete understanding of Vehicle Maintenance Facility (VMF) requirements and operations.

VMF Design Expertise. WBG's Lead Designer, Jacobs, has designed eight shops for transit clients. Our designers understand how to design buildings for this challenging work environment and lay out the various systems and infrastructure in the yard that support these buildings.

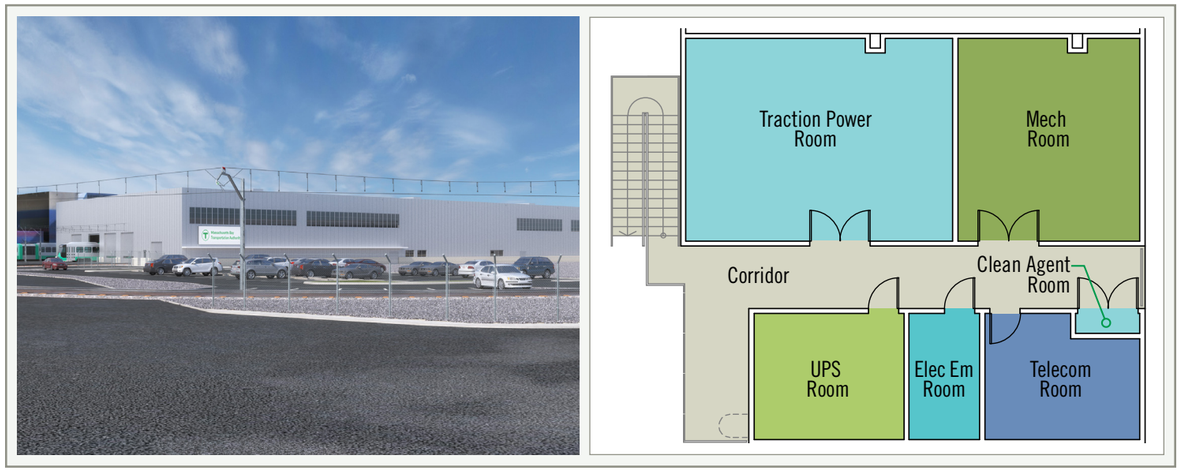
Long Island Rail Road Arch Street Shop and Yard, designed by Jacobs



Metro-North Railroad's Coach Shop, designed by Jacobs

Metro-North Railroad's Coach Shop, designed by Jacobs

Figure 4.5-1 WBG's design refinement for the Vehicle Maintenance Building. Our design includes a mezzanine for mechanical and electrical equipment. The design eliminates the need to grow the building's footprint, while maintaining worker efficiency.



Life Safety

The VMF will be designed in accordance with the following adopted codes, standards and regulations as implemented by the Massachusetts Consumer Affairs and Business Regulation:

- Massachusetts State Building Code (MSBC) 780 CMR (referencing the 2015 International Building Code)
- Massachusetts Comprehensive Fire Safety Code, 527 CMR 1.00
- Massachusetts Architectural Access Board, 521 CMR
- ADA Standards for Transportation Facilities by US DOT
- Massachusetts Electrical Code (MEC), 527 CMR 12.00
- International Mechanical Code, as amended by 780 CMR 28.00
- Uniform State Plumbing Code, 248 CMR
- International Energy Conservation Code, as amended by 780 CMR 13.00
- Massachusetts Board of Elevator Regulations, 524 CMR
- FM Global Standards
- MBTA Guidelines & Standards
- MBTA Guide to Access
- American Public Transportation Association (APTA) Guidelines
- Association of American Railroads (AAR)
- NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

A code summary sheet is provided with our Composite Drawings.

Floor Area Summary

The gross square footage of the VMB is 56,015 square feet, and the net is 53,085 square feet. Our design provides 2,000 additional square feet in the building to provide utility rooms not previously included in the RFP documents. This additional space ensures a functional building that will address MBTA needs. We included a mezzanine for the traction power, clean agent, telephone, mechanical, uninterruptible power supply (UPS), and electrical rooms. Note that the mezzanine will limit the height of the breakroom to 11.5 feet. While less than the requested 14 feet, this height is still more than the customary 9.5-foot-high ceilings provided for most rooms of this type.

Architectural Design Description

The new VMB will be located within the VMF rail yard. The facility will be built in a fairly open area of the yard. To the north of the VMF will be four new tracks and a new parking area to support the facility. To the east of the VMB are existing tracks. Four tracks will enter the VMF from the south and exit on the north side of the building. To the west is an open field that will be reserved for the future expansion of the VMB.

The VMB massing is uncomplicated. The massing is driven by the function of the facility. The one-story rectangular form lends itself to receiving rail vehicles at one end and moving them through to the other end after they have been maintained and serviced. The

rectangular massing also works well in terms of shop operations due to the large spanning structure and high bay areas that support large pieces of equipment such as bridge cranes and wheel truing equipment. The VMB massing allows the facility to blend into the surrounding site, complementing the new Transportation Building located southwest of the facility. Shrubs and smaller trees will be introduced in specific areas of the site to provide natural aesthetics in an otherwise industrial-looking setting. Figure 4.5-2 provides the general building arrangement for the VMB and Transportation Building.

Accommodating MBTA Requirements

The VMB will be designed to comply with the Technical Provisions. These requirements include floor layout, work flow, pit access, mechanical/electrical/plumbing (MEP) requirements, sustainability, safety, durability, and equipment specifications. WBG has included additional rooms to ensure full compliance with the provisions and provide sufficient space for workers and equipment.

The shop is designed for movement of trains by either the overhead contact system or stinger in the crane areas. Pit access, under-track pit lighting, storage layout, work flows, and material movement have all been reviewed and designed into the floor plan. Power to the proposed and future equipment is included, and embedded rails for the future hoist will be provided so that future slab modifications are not needed.

WBG understands and has addressed MEP requirements in the VMB to ensure shop functionality. Rooftop heating and ventilating (HV) units provide 100% outside air and include energy recovery wheels. The HV units, along with exhaust fans and the large train doors on the shop's north and south walls, provide ventilation during summer months. In colder months, the HV units provide heat and are supplemented by gas unit heaters at the shop perimeter.

All required plumbing systems will meet the Technical Provisions, including industrial waste, water, and sanitary. Water-efficient water closets and water flow restrictors will be provided on faucets for lavatories, sinks, and shower heads. Industrial waste effluent will be treated through an oil water separator. Emergency eyewash and showers will be provided in hazard areas.

Translucent panels will be used to provide a bright shop area, and wireless daylight dimming will be used for the high-bay LED lighting. Lighting control systems will be provided in all normally occupied areas, and motion detectors in utility rooms and storage rooms will turn lights on and off automatically. Variable speed systems for all fans, pumps, and motors will be provided to conserve energy.

Physical Working Environment

WBG team members have direct experience working on MBTA maintenance facilities, including work on multiple carhouses at Riverside, Wellington, and Cabot. We have used this experience to address critical factors affecting the physical working environment. One such critical factor is the integration of key systems. An inventory that documents the flow and movement of materials, equipment, and workers throughout the facility provides the basis of design for all aspects of programming.

Another critical factor to consider in design is the environmental separation between the shop spaces that support industrial activities on tracks and smaller spaces that support human comfort. The support facilities have offices, lockers, crew quarters, restrooms, and electronics rooms embedded inside a larger envelope.

Accessibility

The VMB design will provide for an ADA-compliant break room, training room, and restrooms. Since the mechanical rooms, electrical rooms, wheel truing machine area, and pit areas require able-bodied workers to perform industrial activities, such areas will not be ADA accessible. The Transportation Building design will be ADA-compliant to meet the Technical Provisions requirements.

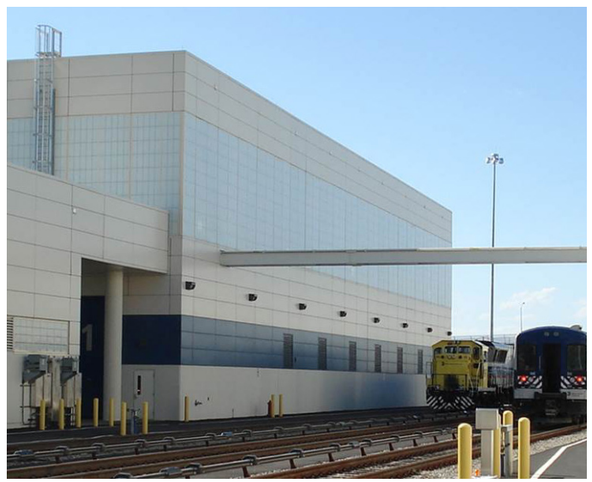
Durability

The exterior materials for the building meet the Technical Provisions requirements, as well as requirements of FM Global. The materials are durable, resilient, and low maintenance. The life span of these materials will exceed the 25-year requirement. The VMB will consist of a steel framing structure with a precast concrete base and an insulated metal wall panel system above. The building envelope will provide continuous insulating properties along the base, walls, and roof. The material and construction of the VMB will be corrosion-free and weather resistant. The Transportation Building will have a matching wall panel system.

Noise, Vibration, and Light Trespass Mitigation

The proposed VMB location was selected from several alternatives to minimize environmental and operational concerns. Previous

Similar to GLX, Jacobs designed Metro-North Railroad's locomotive shop with abundant translucent panels. The exterior's sleek, modern wall panel system uses extensive translucent panels. The interior is bright and energy efficient as a result of these panels that allow daylight harvesting.



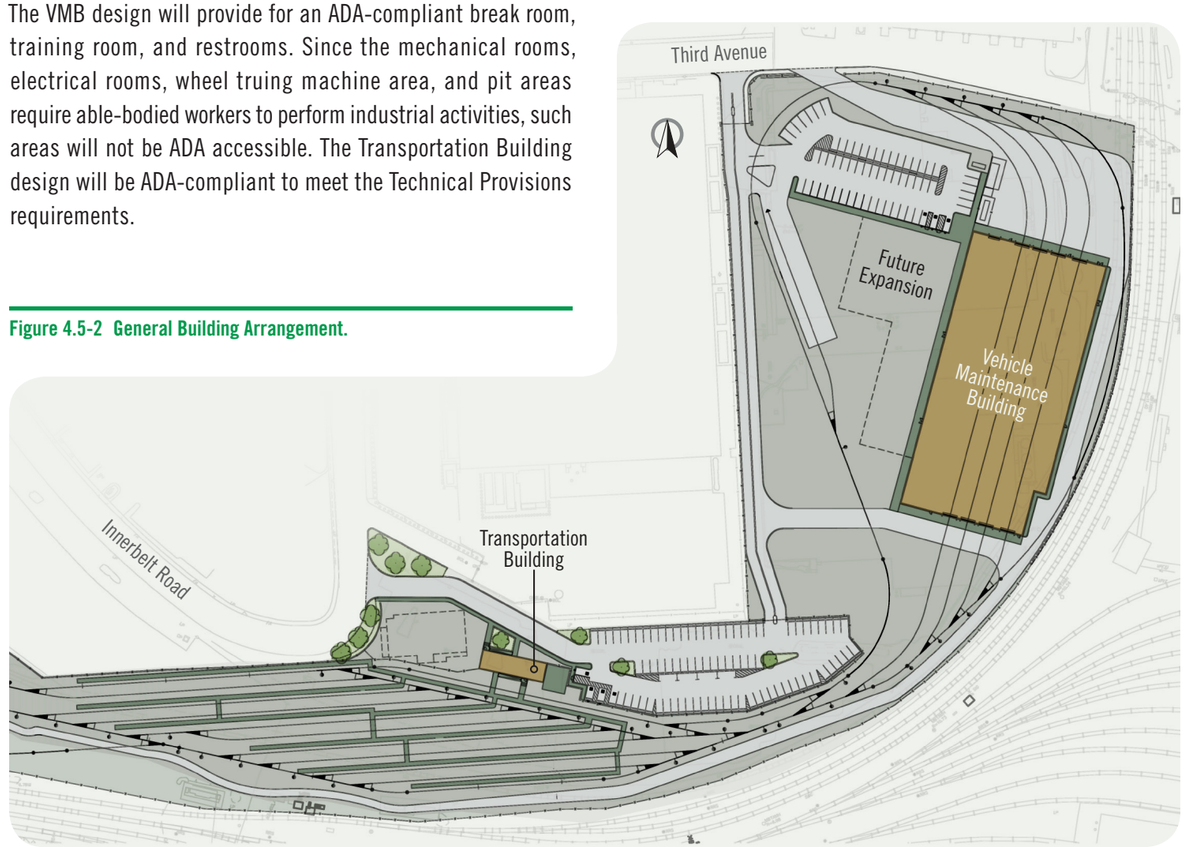


Figure 4.5-2 General Building Arrangement.

studies determined that noise or vibration-sensitive land use that could be affected by VMF operations was limited to the Brickbottom multi-family residential building near the yard leads. Detailed assessments of VMF operation noise and vibration impact will be conducted for locations near the facility based on updated design and land use information, with appropriate mitigation measures designed and implemented in accordance with FTA guidance and the MBTA noise and vibration mitigation policy.

Lighting levels and spill light will be closely reviewed to ensure proper levels for the building location. Luminaires illuminating the building facade will be shielded from view beyond the site boundary. Luminaires not illuminating the building facade with intensities greater than 10,000 candela will be shielded or rated as full cut-off per Illuminating Engineering Society of North America (IESNA) guidelines. Direct illumination onto adjacent properties will be avoided to limit spill light.

VMF Architectural Drawings

VMF architectural drawings are provided in the Composite Drawings.

B. MECHANICAL, ELECTRICAL, AND PLANT

Conformance to Electrical and Mechanical Requirements

Electrical Systems

VMF electrical systems will be designed to comply with MEC, MSBC, applicable local codes, and City of Somerville requirements. The electrical distribution design will incorporate an optimized, energy efficient, and low-maintenance electrical system.

Distribution equipment serving life safety (such as emergency lighting, optional-standby, and other MBTA-defined emergency loads) will be in the Emergency Electrical Distribution Room (EDR). All other distribution equipment will be in the Normal EDR or throughout the facility for an optimized location.

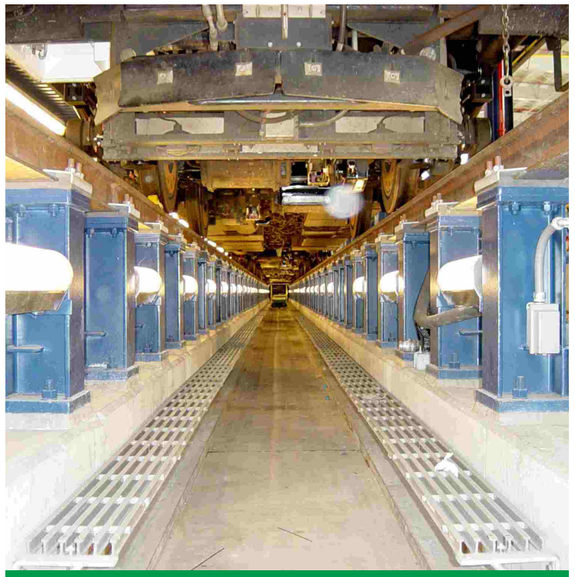
A standby permanent gas generator and multiple automatic transfer switches will be installed to provide power to emergency systems, legal standby systems, and any other loads required by MBTA. Design will adhere to all MEC, NEC, NFPA 110, Massachusetts State Building and all other required applicable codes.

Lighting will be designed using Illuminating Engineering Society's (IES) guidelines to comply with MBTA's light level requirements for indoor and outdoor applications. LED fixtures will be incorporated in the shop areas and at exterior locations, as required by Technical Provisions 13.5.

UPS will be provided as per Technical Provisions 14.5.3.6 to power all life safety loads as defined in Technical Provisions 14.5.3.5.

Where there is sufficient ingress of natural light, shop area lighting will be controlled by lighting control panels with integral programmable controller and network capability to provide daylight harvesting. Lighting controls will be designed to turn lights on or off, or be dimmed in those areas with natural light available. Any daylight dimming will be accomplished via wireless communication to allow seamless calibrations and future flexibility to redefine zones. Additional controls via photocells will be provided in areas defined by the Technical Provisions.

Specialized lighting will be provided for pedestal tracks in the pits. This lighting will be aimed to light both the underside of the cars and the shop floor in order to provide a bright, functional work environment.



For GLX, WBG will provide pit pedestal lighting similar to this Arch Street Shop project, designed by Jacobs for the Long Island Rail Road. The heavy-duty pit light provides a bright work area.

The lightning protection system will be provided by a UL-certified lightning protection installer, complying with UL 96A (Standard for Installation Requirements for Lightning Protection Systems) and NFPA 780-2014 (Standard for the Installation of Lightning Protection Systems).

The building grounding system will be designed in accordance with IEEE 142-1991 (IEEE Recommended Practice for Grounding of Industrial and Commercial Power System) and per recommendations of MBTA as listed on Technical Provisions 14.5.3.7. Final grounding wire sizes, as required by MBTA's standards, will be confirmed during final design.

PA, Fire Alarm Systems, Security, and Other System Elements

A fire alarm system will be provided as per NFPA 72 and Massachusetts Comprehensive Fire Safety Code. The main fire alarm panel will be located in the main communications room, with its remote annunciator housed in the main entrance of the building. Monitoring and control modules for interconnections with systems such as HVAC equipment, sprinkler system, public address system two-way communications, access control, fire pump, and clean agent systems (as required in Section 14.3 of the Technical Provisions) will be provided.

The automatic sprinkler protection provided within the VMB and Transportation Building will be hydraulically calculated based on the available water pressure. A hydrant flow test will be performed. An electric fire pump, jockey pump, and associated controllers are expected for the VMB to boost water pressure. The fire pump will be a vertical in-line pump, with an estimated size of 500 gpm at 65 psi. The jockey pump size is estimated to be 5 gpm at 75 psi. An automatic wet standpipe system will be installed throughout the VMB.

Clean agent protection will be provided within all communication rooms (VMB, Transportation Building, and stations). Clean agent releasing panel will monitor smoke detectors/manual activation within the communication rooms and be equipped with dedicated notification appliances, abort switches, and signage. Releasing panel will communicate with the VMB fire alarm control panel and secondary power will be via battery backup. Two, cabinet-enclosed, self-contained breathing apparatus (30-minute air supply) will be installed outside each communication room. Pre-action sprinkler protection will be provided within the VMB and Transportation Building communication rooms. All sprinkler piping will be Schedule 40. Fire extinguishers will be located throughout VMB and Transportation Building.

The VMF communications and security systems will be based on MBTA and industry standards and, to an extent, are an extension of the GLX station systems. These systems will interface to the existing communications and security systems currently in service at the MBTA, and will follow the Configuration Management Plan.

Public Address System

The VMB public address system will be local to the VMB and will not interface to the MBTA Operations Control Center (OCC). The system will consist of loudspeakers, digital signal processor, power amplifiers, mixers, and microphones. Users will access these systems via analog outputs from the Avaya telephone system.

Security

The VMF will have nodes off the wide area network (WAN) and the security wide area network (SWAN). These nodes will allow the VMF communication and security systems to be integrated into the existing physical security management system (PSIM), the Avaya Voice over IP (VoIP) telephone system, the power and communication SCADA systems, and the corporate IT systems.

The CCTV system provides remote surveillance and video recording of areas in and around the VMF for the operations and security departments and transit police. All video cameras will be incorporated into the MBTA's PSIM system.

Power over Ethernet (PoE) IP-based cameras will be placed within the VMB to view secure rooms. Exterior cameras will be located outside the VMB, within the yard and at motorized lift gates.

The Project will provide video management and storage solutions for the proposed video cameras. Video servers will be added at the MBTA's data center at the OCC to store video.

The Electronic Access Control System (EACS) will provide access through secure portals to users with authorized credentials. Card readers, door contacts, and electric locks will be provided at doors that lead to critical infrastructure, such as communications, electrical, and mechanical rooms. Double card readers and stanchions

Exterior cameras will be located outside the VMB, within the yard and storage area, and at the motorized lift gates. A dual card-reader/intercom at the motorized gate provides additional security.

will be provided at each motorized lift gate. Each card reader will interface to a local access control panel that will then interface to the PSIM via the SWAN. The PSIM will be updated to include alarm rules, such as a door propped or forced open. Some portals require only monitoring (such as roll-up doors) and will be equipped with only magnetic door contacts. WBG will follow the MBTA's Safety and Security Management Plan for the VMF through final design, construction, testing, and commissioning.

Communications

New core (10GBPS) and local area network (1GBPS) data switches will be provided at the VMF (Cisco for the WAN, Extreme for the SWAN). IP address schemes and virtual private networks (VPN) will be developed in coordination with the MBTA to integrate these new switches, and their data traffic, into the existing networks. These data switches will use the new 96-strand communications fiber optic cable extended from Lechmere and East Somerville stations.

To support data and telecommunications services, Category 6 data cable will be provided from the closest communications distribution location to jack locations, as shown on the project drawings. At locations where Ethernet limits are exceeded, communications cabinets will be installed and be connected to the core switches via fiber optic cable. The cabinets will house hardened data switches, patch panels, power supplies, and UPS units.

WBG will provide an Avaya IP telephony gateway at the VMB to provide telephone service (VoIP, digital, and analog) for the offices and support rooms. An ancillary component of the telephone system will be an audio logging recorder. This unit will be configured to record the telephones within the VMB, and to record the MBTA's two-way radio system. In addition to telephone service provided through the Avaya telephone gateway, a Verizon point-of-demarcation will be provided at the VMB to accommodate leased communications services. The proposed VoIP call boxes for the motorized lift gates will be ADA compliant and compatible with the existing AlphaCom server located at the OCC.

Remote monitoring of pumps, generator, and fire alarm panel will be accomplished through the Hub Monitoring and Control Systems (HMCS). Input and output points for the various devices will be connected to a new communications programmable logic controller (CPLC) to be located within the VMB communications room. The CPLC will interface to the servers at the OCC via the WAN.

The power SCADA that provides the remote monitoring and control of traction and unit power substations will connect to the MBTA datacenter at the OCC via the WAN. The power dispatcher graphical user interface screens will be updated to include the new VMF substations.

All of the communications and security systems require back-up power. The back-up power requirements vary among the systems. Each communications and security system will have a rack, panel, or rail-mounted UPS that will provide back-up power. In the event of a power outage, the UPS units will allow the generator to come on-line without the systems losing power.

Mechanical Systems

HVAC System

HVAC Codes: All mechanical work will be designed in conformance with the International Mechanical Code (2009), International Energy Conservation Code, IECC (2015), Massachusetts State Building Code, National Fire Codes (NFPA), and National Institute of Occupational Safety and Health (NIOSH) standards. We will use Boston weather data from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Fundamentals Handbook, 2013.

VMB HVAC: Six rooftop HV units will provide a 100% outside air ventilation rate to the main shop and will include heat recovery using a heat recovery wheel during the winter. During the summer, the HV units will operate with the internal supply and exhaust fans in the HV units supplying 100% outside air, but will not use the heat recovery wheel.

Exhaust fans on the roof will provide summer ventilation for cooling the rail shop. The summer exhaust fans, along with the HV unit internal exhaust fans, will provide approximately six air changes per hour. The make-up air during this operation will come through the open track doors.

Gas-fired unit heaters throughout the rail repair shop will supply the exterior wall area with supplemental heat. The supplemental heat will be based on unit-mounted thermostats for the internal areas' unit heaters, and wall-mounted thermostats for all the perimeter unit heaters.

Support Spaces HVAC: A split system with an air conditioning unit (AC-1) and associated rooftop condensing unit (CU-1) will be provided to condition the support spaces for building personnel. The support space systems will be controlled by area thermostats with their associated Variable Air Volume (VAV) boxes, with electrical reheat coils, and the setpoint controlled by the Building Management System (BMS).

Exhaust fans will ventilate the storage, cleaning, fire pump/water meter, electrical, mechanical, lube oil, air compressor, toilet, and traction power rooms, and the purge fan for the communications room. In addition, a portable ducted fume hood with internal fan and filtration unit will be provided in the welding area, and an exhaust ventilation system with capture hood will be provided in the truck washing area.

Gas unit heaters mounted to columns provide perimeter heat to supplement rooftop units at Long Island Rail Road's Arch Street Shop, designed by Jacobs.

Plumbing and Drainage System

Plumbing Codes: All plumbing work will be designed in conformance with the Uniform State Plumbing Code, International Energy Conservation Code, IECC (2015), MSBC, and Massachusetts Fuel Gas Code.

Plumbing for VMB: A natural gas system will serve rooftop HV units, gas-fired unit heaters, domestic water heaters, truck washing machine, and the gas-fired air curtain for the roll-up door. The natural gas will be supplied from an existing gas main in the area and enter the north side of the building. The utility company will provide a new gas meter and regulators for the service to the building. The gas piping will be routed via a looped piping system located at the truss level throughout the building with piping to the HVAC, industrial, and plumbing equipment.

The domestic water service to the building will serve the water closets, urinal, toilet room lavatories, kitchen sinks, porter mop sinks, emergency eyewash stations (including those with showers), hose bibbs located along the building interior walls, water drops down in the pit areas, the posted rail pit areas, outside water hydrants, and the truck washing machine. Domestic hot water for the plumbing fixtures below the mezzanine will be provided by a gas-fired domestic water heater. Tepid water to the emergency eyewash stations throughout the VMB will be provided by local instantaneous electric water heaters.

Sanitary and industrial waste (IW) drainage systems will be provided in the VMB. The IW drainage system will be separate from the sanitary system in the building. IW will collect drainage from the below-floor trench drains and from catch basins, floor drains, and sump discharge from low-point sump pumps located in pits areas. The discharge from the industrial waste will then flow into an oil-water separator located outside the building. The separate sanitary line will connect to all the sanitary fixtures, including toilets and sinks, and mop sinks in the mezzanine area.

Storm drainage will be provided by roof drains connected to the site drainage system. Overflow scuppers will also be provided to drain runoff in the event a roof inlet is clogged.

A compressed air system for the VMB will provide compressed air to numerous air drops, as supplied from a looped piping system located at the truss level.

Main Mechanical Equipment Schedules

The VMB mechanical equipment schedules include the following:

- HV units, gas-fired heating
- Gas-fired unit heaters for rail shop heating
- Air curtain door heater for one door
- Exhaust fans rooftop, used for summer ventilation
- Exhaust fans for local ventilation of toilet rooms, storage rooms, cleaning room, fire/water meter room, electrical rooms, UPS, mechanical room, communications room (FM-200 purge)
- Exhaust fans serving the truck washing/ventilation hood, lube oil room, the air compressor room, and the traction power room
- Air conditioning units (AC-1, AC-2) serving non-shop personnel spaces
- Split air conditioning units (AC-3/4), ductless, serving the communications room

Building Automated Control System

The VMB will have a building management system (BMS) and automatic temperature controls system. Zone sensors and thermostats will be located in the maintenance areas to control the rooftop HV units for heating and ventilation. Area temperature sensors will be located near the doors for monitoring and freeze protection. The HV units with energy recovery will be controlled only during the heating seasons. The units do not have air conditioning, so the heat recovery will not operate. Summer exhaust fans will be controlled by outside adjustable air temperature sensors. Occupied and unoccupied scheduling for HVAC controls will be provided.

Local thermostats will be used to control areas served by AC-1, such as the breakroom, offices, training room, and parts storage area. These areas will be zoned using VAV terminal units and thermostats for zone control. Temperature setpoints will be adjustable. AC-1 will include controls for enthalpy-based economizer (free cooling).

The rail shop will consist of rooftop HV units, exhaust fans, and one roll-up door air curtain. These standalone systems will be interconnected to the BMS via a twisted cable for monitoring, alarming, and control using BACnet protocol logic controls. The BMS and its network will be interconnected to the HVAC equipment and systems and to fire alarm panels in the VMB and Transportation Building. Critical alarm points will be sent to the MBTA Operations Control Center at 45 High Street, Boston.

Unit heaters will include their own local controls and not be interconnected to the BMS. The air curtain will operate and be controlled by the door switch.

Electrical Utility Service Supply Point

The service utility pole location and its associated 15kV service isolation switches will be further coordinated with MBTA and Eversource along Third Avenue to provide accessible installation and routing. All temporary power to the existing MBTA facilities will be phased and installed with minimal service disruption. The point of service will be near the new Eversource transition vault on Third Avenue. A pad-mounted, cast coil, dry type transformer will step down the utility feed (15kV) to 480Y/277V, and then feed the main 480Y/227V switchboard to distribute power throughout the facility via multiple 480Y/277V distribution panels and 208Y/120V power panels (via 480V to 208V/120V step-down transformers).

Electrical Drawings

Electrical drawings are included in the Composite Drawings.

Mechanical Drawings

Mechanical drawings are included in the Composite Drawings.

C. INDUSTRIAL PROCESS AT VEHICLE MAINTENANCE FACILITY

Design Approach

Functional Design Concept for the VMF

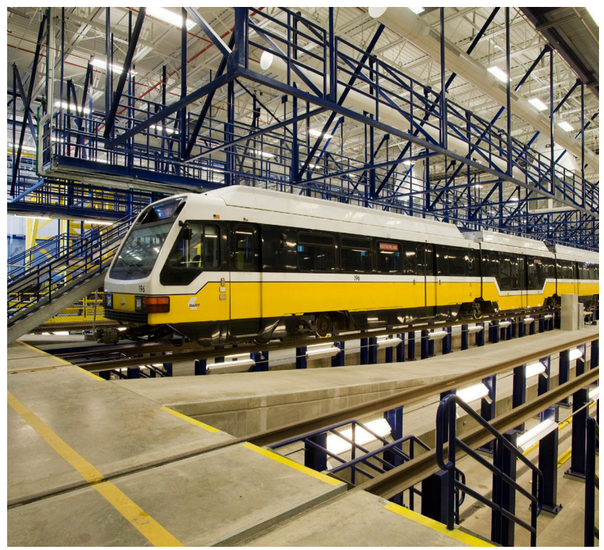
While the VMB must be a bright, safe, and durable facility, it must also be functional. Equipment and utilities need to support maintenance operations so workers can successfully accomplish their tasks. Trains need to move from the mainline to the yard to the shop efficiently, and underground utilities must be designed to avoid conflicts and comply with the Technical Provisions. WBG has the expertise and experience to properly design and build a safe and functional shop and yard.

In the main shop area of the VMB, Tracks 1 and 2 will have pedestal tracks for running repairs, inspections, and light maintenance. The posted tracks will be equipped with undertrain lighting for visual inspections of the under-carriage. They will also have portable work access platforms to provide better access to the sides of the train. The underside of the train will be accessible for changing the gear-case oils and providing brake servicing. Light welding may be performed, so welder outlets will be provided throughout the pit areas. Many other tasks may be completed, including the repair of door closers and some glass change-outs.

Access to the pit level for the pallet jacks, rolling tool boxes, oil containers, and equipment is by flat platform scissor-lifts to and from the center service floor to the pit floor. Tracks 1 and 2 will also be covered with catenary traction power and have methods to power up and to de-power for service and safety. Tracks 3 and 4 are flat tracks with no pits for inspection or work except for the wheel truing pit on Track 3, which will be designed for a wheel milling machine in the future. This pit will have posted rail and be left open so that trains can pass over the pit, with a guardrail to protect shop workers from the opening. The remaining portion of Track 3 will remain open and be left clear of obstructions for the western end of the building so that a rooftop platform can be placed by the MBTA after the completion of the shop. The floor of the building along the track will be finished flat with no rail or guidance for the roof access platform being provided.

There are no catenary wires over Tracks 3 and 4. As established in Addendum No. 6, the movement of vehicles on Tracks 3 and

VMF Construction Expertise. WBG's managing partner, Walsh, has constructed vehicle maintenance facilities similar in size and scope to GLX. DART's Northwest Operating Facility in Dallas, Texas, was part of the over $1 billion program completed as part of their Green Line Extension Project. The facility included a mezzanine similar to what we propose for the MBTA GLX Project.

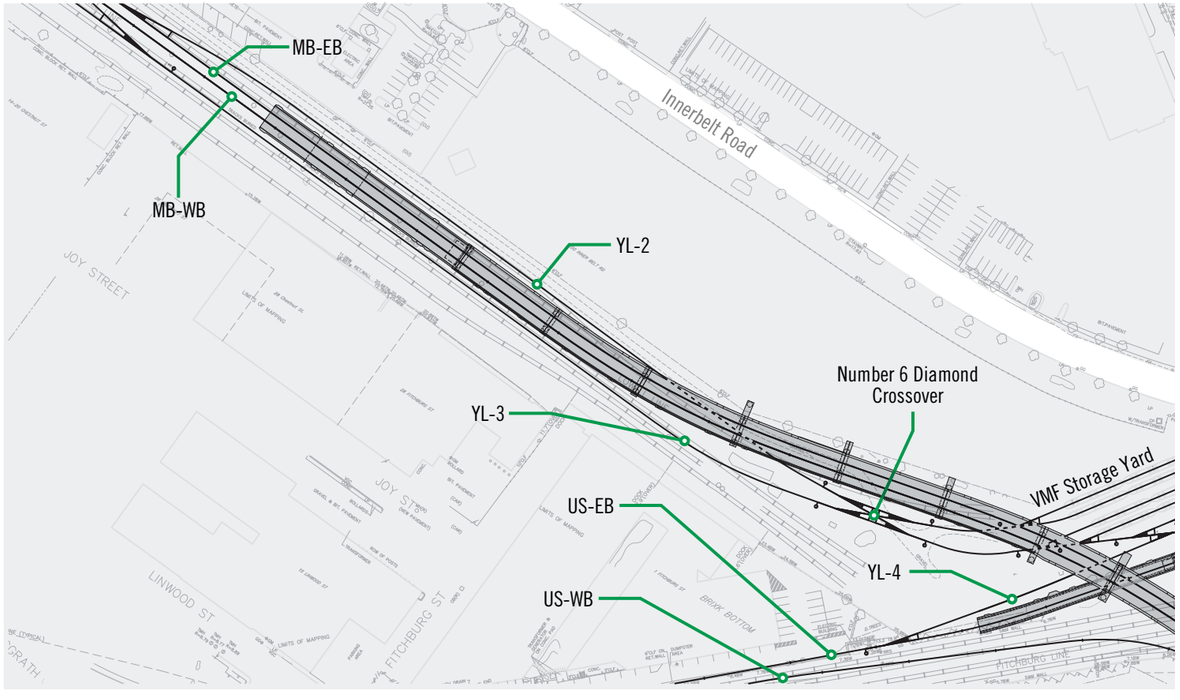


4 will be by a stinger system; therefore, no winches, catheads, or any other methods of advancers are provided. As requested, we have added steps into each end of the service floor to the bottom of the pit between the tracks. This is to allow access for inspection of the train undercarriage between the rails.

Interface with the Main Line

The VMF yard will be accessible by train from both the Medford and the Union Square Branches of GLX (Figure 4.5-3). The Medford Branch connects to the northwestern-most corner of the VMF storage yard using Yard Leads 2 and 3 (YL2 and YL3). YL2 diverges from the Medford Branch eastbound and connects to Track MAF-1 in the uppermost northwest corner of the yard. YL3 diverges from the Medford Branch westbound and connects to Track MAF-1 in the upper most northwest corner of the yard, south of the YL2 connection. West of the yard, a fully guarded #6 diamond crossover provides operational and maintenance flexibility while moving trains and equipment in and out of the yard from the Medford Branch. YL3 diverges from the Union Square Branch eastbound and connects to Track MAF-1 south of the YL2 and YL3 connections. There is only one direct lead from the Union Square Branch; however, the crossover located at approximate engineering station US-EB 20+00 on the Union Square Branch mainline may be used to cross trains from the westbound to the eastbound track and back as operationally needed.

Figure 4.5-3 Yard Interface with Main Line.



Yard Layout and Vehicle Storage

Design of a rail yard is usually more complex than first envisioned, but WBG's extensive experience will allow us to design and build a functional layout that facilitates MBTA's VMF operations. The VMF yard will be separated into two main sections connected by a minimum of two track routes and a series of redundant connection turnouts. This double-track, redundant switch configuration is designed to allow movement from one side of the yard to the other and eliminate a single point of failure location. The primary function of the east section of the yard is train maintenance and maintenance-of-way equipment storage; the west section is for the storage of existing Type 7 and Type 8 LRVs, as well as future storage for the proposed Type 9 vehicle during off-peak and non-revenue hours. The storage yard will be designed to accommodate a minimum of 43 LRVs at any one time in single, pair, and triple revenue configurations for full operational flexibility. The storage yard will consist of 11 tracks in parallel with a ladder track at each end and a run-around track on the east side for direct access to the maintenance side of the yard from either the storage area or the mainline. The revenue vehicles will be stored in a powered and ready state. Access to the stored trains will be available via asphalt walkways between every other storage track for safe and convenient access by maintenance, yard, and operations personnel.

The yard will be designed with an overhead contact system, utilities, fire hydrants, drainage, paved roadways, lighting, signing, and striping. Pressure lines will be protected by casing sleeves under the tracks. Power and truck access will be provided to the compactor and bailer. Below-surface infrastructure (the sanitary pump station and oil water separator) and above-grade facilities (the generator and transformer) will all be located in appropriate places.

Shop Equipment List

Please see drawing MAF-EQ-2101 in the Composite Drawings for a complete shop equipment list. WBG has designed facilities with wheel truing machines (Figure 4.5-4), such as will be provided for GLX. In designing these facilities, consideration must be given for the removal of waste millings, or chips, and removal of heavy machine parts for maintenance. The wheel truing machine for the VMB is not located along an exterior wall; therefore, it cannot convey chips outside. Instead, the chips must be collected in a container and hauled outside via forklift. The bridge crane could also be used to take chips to the door for loading on a truck. The 10-ton bridge crane to be furnished for GLX can easily lift out parts for maintenance.

Industrial Design

Most of the industrial operations will take place along Tracks 3 and 4 (Figure 4.5-5). Track 4 facilitates the changing of the trucks (bogies) from any A-B car set. The single hoisting unit has three pits with jacks and body stands to support the A-B train set. It allows a single truck to be lowered back to the floor level, turned 90 degrees to the main track, and rolled onto the off track. Once into the shop area, the truck may be lifted by the 7.5-ton bridge crane and transported throughout the workshop area. The truck may be placed in the wash area for clean up or on the work hoist for inspection, certain testing, or light repairs. Should the unit require transport to another facility for heavy repairs or rebuild, it would be placed in the waiting area within the shop or placed on an open bed truck for transport. The 7.5-ton crane will service the entire workshop area. The truck unloading area within the workshop is to remain open for heavy (up to 7.5-ton loads) that are to be trucked into or out of the facility. Once set on the floor by the crane, a forklift can transport and place equipment, parts, or supplies in temporary storage within the facility.

Figure 4.5-4 WBG's Past Experience with Wheel Truing Facilities. Jacobs has designed facilities with wheel truing machines, including Metro-North Railroad's wheel truing facility. This facility housed only the second tandem machine in the United States at the time of construction (2007).

A 3-ton bridge crane is used for the cutter heads and other heavy repair parts to be safely lifted out of the wheel truing machine.

This tandem axle machine allows work on four wheels at a time. Chip collection and disposal occur outside of the building.

In all cases, the train on the hoist will remain in the air until either the truck is returned with repairs, or a rebuilt unit is placed into the train. The train will then be lowered to the running rail and tested for return to service.

At the south end of Track 4, three additional pits will be constructed for the future addition of a second train hoist system. For safety and practicality, the open pits will be bridged over with steel beams and a concrete deck. Later, the deck can be removed and the machinery placed in the pits. Conduits will be provided to accommodate future wiring.

A second bridge crane over Tracks 3 and 4 will have a rating of 10 tons and the ability to cover the entire length of the tracks inside the building. This crane will be able to lift air conditioning units off the top of the cars as well as other equipment. The equipment can then be transported north-south or east-west in the air to set down on the floor beside the train units. Normally, the equipment would be placed on a wheeled cart to be rolled to the shop and again cross under Column Line 2 into the shop for testing repair, or a new or rehabilitated unit can be hoisted on top of the train to replace the removed unit.

Should the second hoisting machinery be placed on the south end of Track 4, the 10-ton crane would be more than adequate to remove and transport the truck to the north end of the shop. From there, it would be transferred to the workshop under Column Line 2 via the existing set-out tracks entering the workshop from Track 4 for repair or transport.

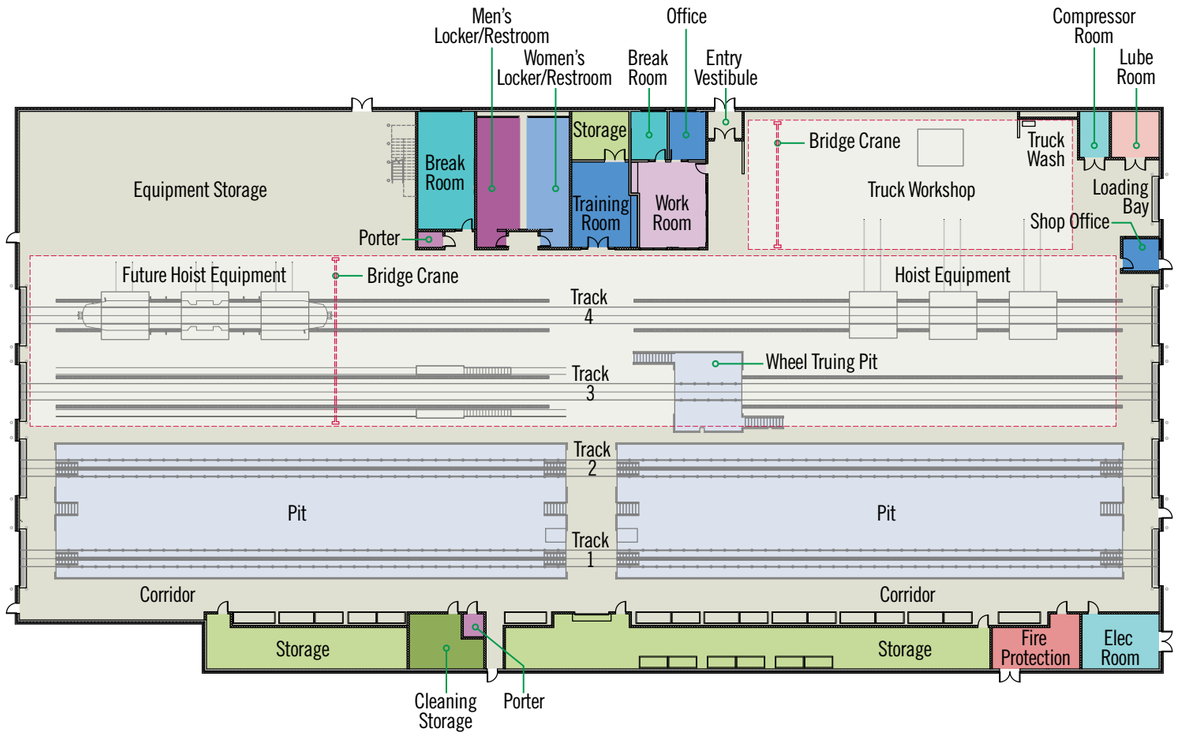
As indicated on the plans, either rails or a slot for out-take tracks on the south location toward the storage area and the slab would be made thicker at those areas to accommodate future hoist equipment. The removed trucks or other equipment would be transferred to the north end workshop and then to the set-out tracks to allow transfer to the workshop area to test or repair the removed equipment. This can be done for any equipment via rubber tired transfer vehicle under the crane beams from Tracks 3-4 and the shop/truck bay.

The rest of the operation in the VMB will be cleaning and storage, with racks for pallet storage and shelves for smaller parts and supplies. A 4,000-pound capacity forklift for very narrow aisle service will be furnished with the ability to turn and extend the forks at 90 degrees to the alignment of the mobile direction of the forklift.

Additional small equipment for the delivery and storage of oil along with compressed air and welding receptacles will be furnished for light and temporary repairs. No heavy welding is expected, planned, or requested for this shop as no special hooding and venting was requested in the RFP.

Sand can be delivered to the facility from the south end of Track 4 in small bags from outside via forklift on pallets through the south train door for storage adjacent to the south end of Track 4. It can then be hand-delivered to the vehicles in the shop. A 20 cubic yard trash compactor and a vertical bailer are located outside of the shop on the north end to allow disposables to be picked up in a safe manner.

Figure 4.5-5 The VMB floor plan showing major equipment and crane coverage.



2. VMF Drawings

Drawings showing WBG's approach demonstrating how the design for the VMF will conform to the requirements of Volume 2 Technical Provisions, Section 10.0, are provided in the Composite Drawings.

D. BUILDING STRUCTURES

VMF Structural Design Approach

WBG designed the VMB as a one-story structure with a partial mezzanine that will accommodate LRV service and maintenance, and provide associated office spaces.

Design Criteria and Standards

Figure 4.5-6 provides a summary of the codes and criteria WBG will use in the final design.

Figure 4.5-6 Design Criteria and Standards.

Codes, Standards, and Manuals

- Massachusetts State Building Code, 780 CMR
- ASCE 7, Min. Design Loads for Buildings and Other Structures
- AREMA Manual for the Railway Engineering
- AISC Steel Construction Manual
- AISC Design Guide 11: Floor Vibration Due to Human Activity
- AISC Seismic Provisions, as amended by 780 CMR
- ACI-318, Building Code Requirements for Structural Concrete
- ACI 301, Specifications for Structural Concrete
- ACI-530, Building Code Requirements for Masonry Structures
- AISI S100, Specification for the Design of Cold Formed Steel Structural Members
- AWS D1.1, Structural Welding Code - Steel
- AWS D1.3, Structural Welding Code – Sheet Steel
- AWS D1.4, Structural Welding Code – Reinforcing Steel
- MBG 531, Metal Bar Grating Manual
- AASHTO LRFD Bridge Design Specifications, as supplemented by the FHWA Drilled Shaft Manual, the latest edition
- ASME Safety Code for Elevators and Escalators A17.1
- Guide Specifications for Structural Design of Rapid Transit and Light Rail Structures
- FM Global Property Loss Prevention Data Sheets; 1-28 Design Wind Loads, 1-31 Metal Roof Systems, and 1-54 Roof Loads for New Construction
- MBTA Railroad Operations Commuter Rail Material Specifications, Commuter Rail Design Standards Manual, and Book of Standard Plans – Track and Roadway

Design Methodology

- Steel Elements - Allowable Stress Design (ASD) or Load and Resistance Factor Design (LRFD) Method
- Concrete Elements - Ultimate Strength Method
- Masonry Elements - ASD or LRFD Method

Live Loads

- Corridor - 100 PSF
- Offices - 50 PSF
- VMB main floor - 250 PSF, 3000-pound concentrated
- Mechanical rooms - 100 PSF
- Stairways - Maximum of 150 PSF or 100 PSF with concentrated forces of 300 pounds on the center of tread
- All other areas - Per Mass Building Code 780 CMR

Crane Loads

One 10-ton and one 7.5-ton top running bridge cranes. Unless the crane manufacturer's design specifies higher impact loads, the following impact will be added to increase maximum vertical wheel loads:

- **Vertical impact:** 10% of maximum vertical wheel load for pendent-operated bridge crane
- **Transverse force:** Applied to the traction surface of runway beam in either direction perpendicular to the runway beam; 20% of rated capacity plus weight of hoist and trolley
- **Longitudinal force:** Applied on crane runway beam; 10% of maximum wheel loads of the crane

Serviceability Criteria

Maximum Deflections

- Floor Framing Deflections - Live Load Deflection = L/360 Total Load Deflection = L/240
- Roof Framing Deflections - Live Load Deflection = L/240 Total Load Deflection = L/180
- Lateral System Deflections - Wind Load Deflection = L/400 and Seismic Load Deflection per ASCE 7, Section 12.12

Bridge Crane Criteria

All cranes classified as Class C, as defined in the CMAA Spec. No. 74 (2004). Building designed in accordance with the AISC Manual of Steel Construction, except as supplemented in the AISE Tech. Report No. 13. In addition to applicable codes and standards, areas with cranes designed per the following criteria:

- Building frame lateral drift at top of the crane girders to be lesser of 1/400 of the height from column base or 2 inches.
- In addition to dead and live loads, crane girders and supporting structure designed for impact, longitudinal, and lateral forces, with the most severe loading condition and crane(s) in the most critical position, in accordance with AISC/AISE.
- Adequate bracing provided to resist concentrated localized forces caused by crane operation.
- Crane girder deflection for live load without impact to be less than L/1000 vertically, and L/400 laterally; structural members supporting cranes designed to limit deflection less than 1 inch.
- Crane girder checked for the local longitudinal bending stresses in the top flange of the girder due to crane wheel passage.
- The end sections of the crane runway designed for a longitudinal force applied to the crane stops.

Structural Elements

The VMB's primary structure will consist of a steel-framed building, slab-on-grade, and foundations/piles. We will select the best option between a conventional or a pre-engineered steel building to minimize design and construction times without compromising design or quality. The building will satisfy the strength and serviceability limits per applicable codes, standards, and manuals. We will design braced or moment connected steel frame to take the lateral loads and control deflection. ATC 1 will allow us to streamline any cold weather concrete construction while still building structures that meet the technical requirements of ACI 306.1.

One cost saving measure we introduced was limiting the clear span between columns in the truck hoist area. The RFP showed a 73-foot span between Columns 20 and 2R. This long span was problematic since it carried the 10-ton bridge crane and thus resulted in very high loads at center span. By adding two columns that did not interfere with the hoist operations, we were able to significantly reduce the size, and therefore cost, of this beam by limiting the span to 26 feet.

Building columns will be supported by concrete pile foundation. Grade beams around the building perimeter will be provided to connect the pile caps and support the precast concrete perimeter wall. The first floor, including the pit floors, will be designed as reinforced concrete slab-on-grade, supported on crushed stone and compacted fill. The continuous reinforcement in the slab-on-grade, with dowels to grade beams, piers, pile caps, and footing wall, will connect all the pile caps. The mezzanine floor will be slab-on-metal deck.

Top-Down Construction Method

Since the VMF must be operational for revenue service to begin on either of the branches, its design and construction lies on or close to the critical path. WBG's experience with maintenance shops will allow us to design and sequence the work so that the facility is ready on time. Invariably, we have found that the systems and equipment require the most time to design and build. These elements are complex, require coordination from the operating groups, and entail long lead times to procure and install specialized equipment. WBG understands these shops and proposes a top-down construction approach (Figure 4.5-7) to mitigate the associated schedule risk.

Key to this approach is to allow work in the field to proceed concurrently instead of consecutively. Many contractors build from the ground up, but this requires the underground systems and floor slab to be in place before the superstructure can proceed. Expediting the design of the foundation system and superstructure allows us to build top-down, providing more time for the systems and equipment design and installation.

Our first step will be to take borings before the existing buildings on the site have been demolished. We plan to get the rigs inside the buildings and use mechanical ventilation for the exhaust. This will allow us to obtain the lab results we need for design without having to wait for building demolition work to be completed.

Using the lab results, we will release the foundation early works package and begin to install the piles in late summer of 2018, immediately after building demolition. The superstructure will be released allowing fabrication to begin in early fall. Our design facilitates this approach, as the foundation system for the columns is separate from the floor slab. This separation will allow the piles, pile caps, and superstructure to be installed without the slab in place.

Figure 4.5-7 Top-Down Construction of the VMB. This method will allow us to design and sequence the work so that the facility is ready on time. Our member firms have had success using this method to expedite schedules through concurrent work.

At the Metro-North Coach Shop, designed by Jacobs, the superstructure is up, the utilities are installed, the waterproofing is in place, and the floor slab work is following behind in the distance.

Walsh used the top-down method to accelerate construction of the VMF building shell at the Tampa Airport People Mover project in order to optimize mechanical and process systems embedded in the base slab.

Grade beams will be used for lateral support, and the piles will be able to accommodate uplift forces. The design meshes seamlessly with the construction approach.

While this field work is proceeding, the design detailing of the systems and shop interiors will continue. Proper time will be provided for coordination with the MBTA and for design development of a functional shop layout. The design will be completed toward the end of 2018. This will allow the winter of 2019 to be used to submit shop drawings and procure materials. Once the weather improves, the underground systems will be installed beneath the superstructure. This includes communications conduits, power duct banks, drainage systems, waterproofing and other buried infrastructure. Concurrently, the facade and roofing systems will begin to be installed on the in-place superstructure. And final pit elements with embedments that match the selected equipment will be installed with the pit formwork.

The key benefit of this top-down construction approach is the ability to work concurrently. Construction of the superstructure and building envelope will be well underway, as will be the work on underground systems and pits. The floor slab will follow the installation of the buried utilities. By advancing the work concurrently, we will be able to create more time for the electricians to install, test, and commission the systems in the shop (from stingers, fire alarm, and HVAC, to communications, emergency systems, and controls)—activities that take considerable time in the schedule. This top-down construction approach will greatly reduce the time needed to construct the VMB and will ensure ample time for design development and detailing.

Transportation Building

Structural framing for this one-story building will consist of a braced steel frame with steel W beams for the roof members and W or HSS square tube members for columns. Columns will be supported on reinforced concrete spread footing, and the CMU/brick perimeter wall will be supported on concrete wall footing. Roofing for this structure will consist of light-weight concrete on galvanized metal deck. The first floor slab will be a slab-on-grade supported on crushed stone and compacted fill.

Waterproofing System

WBG will provide the positive-side membrane waterproofing system on the exterior surfaces of hoist pits and the wheel truing pit, up to where the pit walls meet the first floor. A vapor barrier will be provided under all slabs.

Frost Heave

We will place building foundations four feet deep to mitigate frost heave.

Right-of-Way

The VMF will be constructed within the site limits indicated on the RFP drawings. Two retaining walls will be constructed to ensure that grading does not spill outside of the identified site limits.

2. VMF Structural Drawings

Structural drawings are provided in the Composite Drawings.

CIVIL AND GUIDEWAY

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.6 Civil and Guideway

WBG's integrated track level design uses innovative structural concepts incorporated through our ATCs that provide enhanced access and safety for users of the Community Path, while optimizing track alignment and site lines. Clear access will be provided for long-term maintenance at traction power substations, and signal and communications infrastructure.

A. MEETING REQUIREMENTS

WBG's design complies with the Technical Provisions and features a number of design improvements. During preliminary design, we reviewed the track geometry for both the Green Line and commuter rail tracks to ensure that the track geometry met the required standards. We identified opportunities to adjust alignments, which has resulted in reducing some bridge spans and retaining walls. These adjustments have been built into our base design.

Following the setting of the track geometry, we then considered other elements including the revised Community Path alignment and retaining walls. We also considered structural solutions for bridges and underpasses to minimize structural elements while supporting the need for an integrated guideway corridor, Community Path, and access to stations. Constructability, construction staging, and impacts on the surrounding community were all evaluated, resulting in a compliant, constructable design that meets the needs of the MBTA and local end users.

Alignment Design Elements

The MBTA Medford Branch, Union Square Branch, Vehicle Maintenance Facility (VMF) yard and yard lead tracks will be new, ballasted wood tie construction, utilizing fully destressed continuously welded rail (CWR) 115R E running rail, 15/16-inch screw spikes, and resilient plate and fasteners in accordance with the RFP documents and the Light Rail Transit Track Maintenance and Safety Standards (LRTMSS). Based on this proven track structure design, the track will be constructed with minimal design limitations, allowing for safer, more comfortable, and faster train service for the riding public and MBTA personnel.

Available space within the right-of-way corridor allowed WBG's design team to provide a higher speed and safer design, while still providing the required clearance envelope. Our design:

- Implements longer spirals and higher speed super-elevated curves to increase the train speeds between stations and provide a safer, smoother ride
- Implements AREMA-sized, fully guarded, flange-bearing turnouts, improving the safety and efficiency of crossing trains along the GLX mainlines
- Provides increased line-of-sight distances, improving safety for the riding public at stations and crossings, as well as for maintenance personnel and LRV operators

The MBTA New Hampshire Main Line (NHML) commuter rail will be ballasted, wood tie construction using fully destressed 132#, CWR throughout the project limits. The NHML track will be designed and constructed to meet FRA Class 5 track for maximum allowable train speeds of 79 mph for passenger trains and 60 mph for freight trains. The NHML track geometry has been designed to support future passenger train speed increases to 79 mph with superelevation modifications. To control ambient train noise and vibration, mitigation in the form of ballast mat will be installed on the subgrade below the tracks in locations designated in the contract plans.

Clearances along the line will be in accordance with the contract plans, specifications, and the Commuter Rail Design Standards Manual (CRDSM) – Section 1, Chapter 6 clearance criteria. Maintenance and emergency egress walkways will be provided per the contract plans and specifications and in accordance with the National Fire Protection Association (NFPA) requirements.

Transition ties will be used as specified in MBTA Railroad Operations Book of Standard Plans– Drawing Number 1108 – Transition Ties, whenever a significant change in track modulus occurs at locations such as rail bridges, wood to concrete tie transitions, and at-grade crossings.

WBG remains aware of the unique challenges and limitations posed by the current Green Line Type 7 and Type 8 LRV fleet, and the proposed Type 9 LRV cars. We have adhered to the Technical Provisions and current track standards, from the LRTMSS as well as the Book of Standard Trackwork Plans (BSTP), to ensure that clearance criteria is met, particularly in regard to end and middle overhang adjustments related to the Green Line LRV design. In light of the low profile of these vehicles, the vertical curve tolerances and clearance envelope parameters have been strictly followed during design.

Design Speed

The horizontal track alignment, vertical track alignment, alignment through areas of special trackwork, and horizontal and vertical clearance requirements have been designed to accommodate a maximum design speed of 50 mph wherever possible, and to incorporate sufficient superelevation and spiral lengths necessary to safely and smoothly transition the LRV into and out of curves at speed. In cases where the 50 mph cannot be met due to operational, geometric, or physical limitations, the maximum speed was calculated and incorporated into the design.

Transitions Between Various Track Bedding Types

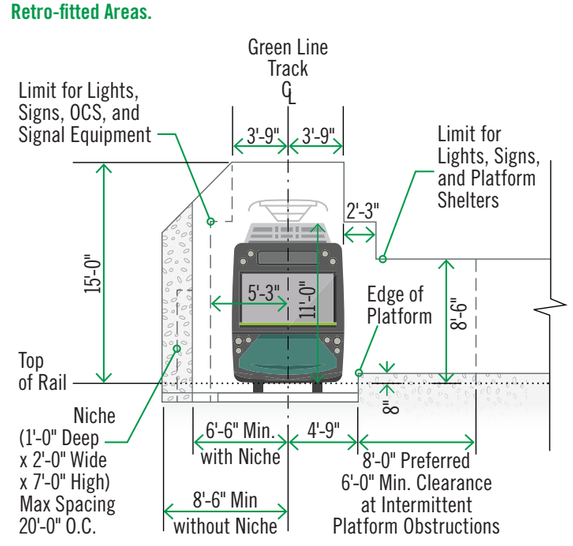
WBG will give special design consideration when transitioning the track modulus and track stiffness. Track modulus is a measure of the vertical stiffness of the rail foundation, and track stiffness is a measure of the vertical stiffness of the entire track structure. Both are related to the track system's performance, maintenance requirements, reliability, and ride quality. Typical track construction will include a layer of compacted, sloped-to-drain sub-ballast installed on top of the subgrade.

WBG will install industry-proven track modulus attenuation methods at transitions between different track bed construction types. Typical measures include the use of ballast mats, asphalt underlayment, and transition tie spacing, based on the needs and type of the transition, in order to achieve a properly maintained track surface for both the short- and long-term life cycle of the track system. Well designed and constructed track modulus and stiffness transition zones are critical to track safety, reliability, and reduced operations and maintenance costs.

Clearance Envelope

WBG developed typical clearance diagrams for both the commuter rail and Green Line corridors. Where standard clearances were not obtained, code compliant safety niches have been provided. This includes the safety niches required to be retro-fitted to the Cedar Street bridge abutment. Otherwise, a minimum standard clearance of 8-foot 6-inches on tangent track has been maintained. This horizontal offset clearance requirement increases with track curvature and other wayside factors that have been integrated into the design. Details of the clearance envelopes and egress walkways for the Green Line are shown in Figure 4.6-1.

Figure 4.6-1 Standard Clearances and Safety Niche Requirements for Retro-fitted Areas.



Notes

LRV Dynamic Envelope dimensions per MOW Standard Drawing No. 160

Dimensions shown do not consider Other Wayside Factors (OWF) and Running Clearance (RC) requirements

Line of Sight and Approaching Stations

Line of sight considerations have been reviewed at all approaches to stations and with regard to the placement of wayside objects and signage. Our approved ATC 2 at Walnut Street improves line of site. Vertical geometry has also been reviewed, paying particular attention to crest vertical curves that potentially limit operator lines of sight.

Structural Crossings

The structures have been designed to meet required clearances. At the Washington Street and Harvard Street bridges, a shared egress walkway in the center of the structure has been adopted for use by both the NHML commuter rail and the Green Line. At each of these locations, the track structure is proposed to be a ballasted deck in accordance with contract standards.

Special Track Work

The light rail mainline special trackwork includes turnouts, cross-overs, and diamond crossings designed to interconnect the rail system along the mainline from one track to another and from each branch line to another, including interconnectivity to the VMF via yard leads for equipment moves and operational flexibility. The size, location, and type of special trackwork depends on its purpose, and has been designed and located in such a way as to provide the MBTA with the means to move trains and equipment safely and efficiently, and to provide the riding public with the fastest and most reliable service possible.

Geometric Horizontal and Vertical Alignment Criteria

The horizontal and vertical track alignments for the MBTA Green Line allow for safe, economical, efficient, and comfortable transportation for passengers while maintaining adequate protection with respect to overall operation, maintenance, and vehicle stability. The criteria set forth by the MBTA, and adhered to by the WBG design team, meet or exceed LRT engineering practices and are consistent with the operational expectation of the current Green Line LRT system.

The NHML commuter rail alignments within the project limits are designed to meet the various criteria listed in Technical Provisions Section 10, and follow the MBTA's Railroad Operations Commuter Rail Design Standards Manual. The alignment design also meets applicable AREMA and FRA Class 4 criteria that allow passenger train speeds up to 79 mph. The NHML corridor alignment design accommodates regional freight rail carriers and Intercity Amtrak Downeaster service.

Two separate and distinct track construction methodologies and criteria associated with the GLX Project are described in Figure 4.6-2. In all cases, superelevation will be used for passenger comfort and to maximize running speeds where it does not interfere with stations or other operational speed requirements. Actual superelevation will be attained and removed linearly throughout the full length of the spiral transition curve by raising the outside rail while maintaining the inside rail at the rail profile grade. The vertical alignment will contain constant grade tangents connected by a parabolic curve having a constant rate of change.

Our design identified a number of areas where track geometry created tight clearances. In these areas, WBG reviewed each cross section for clearance and adjusted the track geometry to ensure standards compliance and fit within the right-of-way. These areas include both the Central Street and Walnut Street overhead bridges.

Our design also identified areas where improvements to the geometry allowed for reduced walls and bridge spans. Other improvements made to the Green Line alignment north of College Avenue maximize use of existing right-of-way, significantly reducing the size of retaining walls along the western side of the alignment. This improvement is critical for future construction at the high school to be located adjacent to the GLX track. These changes maintain the functionality of the terminal station tracks, keep the platform straight, and do not exclude a future platform extension.

Details of vertical and horizontal geometry including curve data are shown on the plan and profile drawings.

Wayside Elements

Following the review of track geometry and the re-design of the Community Path, WBG shifted focus to the addition of other elements that need accommodation within the guideway. We created CAD overlays to show security fence, intertrack fence, access roads, hi-rail access pads, signal bungalows, and the Community Path. By using overlays, we were able to confirm the placement of each item.

Figure 4.6-2 Design standards for the two distinct track construction methodologies for the GLX Project.

NHML Commuter Rail Track

Design Standards: WBG will design and install the NHML commuter rail track in accordance with the Technical Provisions and the following standards and manuals:

- ☑ Manual for Railway Engineering published by AREMA
- ☑ MBTA Railroad Operations, Commuter Rail Design Standards Manual
- ☑ MBTA Railroad Operations, Book of Standard Plans, Track and Roadway
- ☑ MBTA Railroad Operations, Track Maintenance Standards
- ☑ MBTA Railroad Operations Directorate, latest version
- ☑ MBTA MW-1: Specifications for Construction and Maintenance of Track
- ☑ MBTA Commuter Rail Material Specifications
- ☑ NFPA 130: Standard for Fixed Guideway Transit and Passenger Rail Systems

Horizontal and Vertical Alignment: The horizontal and vertical alignment of the NHML will consist of tangents joined by circular curves with spiral transition curves. The circular curves and superelevation will be related to the design speed and the acceleration and deceleration characteristics of the MBTA commuter rail equipment. The track geometrics will accommodate the maximum design speed of 79 mph for Class 5 track in accordance with the Technical Provisions and all applicable standards set forth by the MBTA.

Curvature:	Chord Definition Degree of Curve (Dc) = 2 Sin-1 (50/R)
Superelevation:	Equilibrium (Ee) = 0.0007 DV2 Unbalanced (Eu) = 1.5" preferred Actual (Ea) = Ee - Eu
Spiral:	Length of Spiral (Ls) = 83 Ea (formula is speed dependent)
Vertical:	Rate of Change (r) = 2000/V2

Green Line Track

Design Standards: WBG will design and install the Green Line track superstructure in accordance with the Technical Provisions and the following standards and manuals:

- ☑ MBTA MOW Green Line LRT Track Maintenance and Safety Standards
- ☑ MBTA, Standard Track Work Plans
- ☑ NFPA 130: Standard for Fixed Guideway Transit and Passenger Rail Systems
- ☑ MBTA Railroad Operations, Commuter Rail Design Standards Manual
- ☑ MBTA Railroad Operations, Book of Standard Plans, Track and Roadway
- ☑ MBTA Railroad Operations, Track Maintenance Standards
- ☑ Associated MBTA and AREMA standards

Horizontal and Vertical Alignment: The horizontal and vertical alignment of the Green Line will be designed to accommodate the current fleet of Type 7, Type 8, and future Type 9 LRVs. Curvature and superelevation will be related to the characteristics of the vehicle design, and the effects of acceleration, deceleration, and speed command levels of the signal system. Within the VMF, track will be designed to include operational requirements and to minimize track and vehicle wear. Track alignment criteria will be designed in accordance with the Technical Provisions and all applicable standards set forth by the MBTA.

Curvature:	Radius Definition (R) = CL Radius Min. Mainline Radius = 275' Min. Yard Radius = 120'
Superelevation:	Equilibrium (Ee) = 4.011 (V2/R) Unbalanced (Eu) = 0.5" preferred Actual (Ea) = Ee - Eu
Spiral:	Length of Spiral (Ls) = 40(Ea), SE Runoff 1" in 62' preferred
Vertical:	Length of Curve (LVC) = (Grade1- Grade2)100

We have assessed cross-sectional elements to confirm sufficient width to accommodate overhead catenary system poles, egress walkways, and conduit duct banks for communications and traction power, paying particular attention to the required clearances.

Security Fence

Security fencing surrounding the site has been designed in accordance with the Technical Provisions. The design of the fence includes all required gates and combines 8-foot-high and 6-foot-high sections of fence as required by the Technical Provisions.

Intertrack Fence

A 4-foot-high intertrack fence will separate the NHML and Green Line tracks as required by the Technical Provisions.

Access Roads

Access roads have been provided to hi-rail access pads at Tufts Interlocking, Ball Square Station, Magoun Square Station, and south of East Somerville Station at Joy Street. Access roads have also been provided to signal equipment, pump stations, and the traction power substations.

Conduits

Conduits for communications, signals, and traction power have been routed to avoid conflicts with other infrastructure elements within the guideway.

Community Path

The Community Path has been re-designed to meet the requirements of the Technical Provisions (Figure 4.6-3). The path matches into the existing Somerville Community Path near Lowell Street and heads south through Junction Park to Central Street where the path crosses the corridor to continue south on the eastern side of the railway. The path re-crosses the corridor at School Street, ultimately matching into the Washington Street bridge at the East Somerville Station.

With ATC 2, WBG has also introduced an at-grade crossing at Walnut Street to improve path access for the community. This ATC not only enhances the path by creating additional access points, it also improves visibility and safety by eliminating a pedestrian underpass.

The Friends of the Community Path created various concepts for the path. We have incorporated some of these concepts into our Community Path design, including at Walnut Street where our ATC 2 design provides an additional street-level connection. After award, WBG's final design will consider incorporation of additional concepts from this community group.

Civil Infrastructure for Signaling and Communications Equipment and Electrification

WBG's integrated design approach has coordinated the civil design requirements with the railway systems. Elements that have been considered and allowed for include:

Communications:

- **Signal and communications cable troughs:** Identified locations and included on the cross sections
- **Conduits and pull boxes:** Incorporated into the concept design and considered in the development of the cross sections
- **Wayside telephone mountings and foundations:** Identified locations and conduit needs
- **Camera pole foundations:** Identified locations for cameras required on platforms, walkways, wayside, and in the storage yard, with sufficient room for appropriate foundations
- **Variable message sign pole foundations:** Identified locations, with sufficient room for appropriate foundations
- **Communications cabinet foundations on platforms and walkways:** Identified locations with sufficient room for appropriate foundations; located "City of Somerville" standard emergency phones on the Community Path drawings, including provision for a MassDOT foundation

Road access to central instrument house/signal instrument house:

- Designed access roads to signal equipment where possible; in some cases, provided access via station platforms.

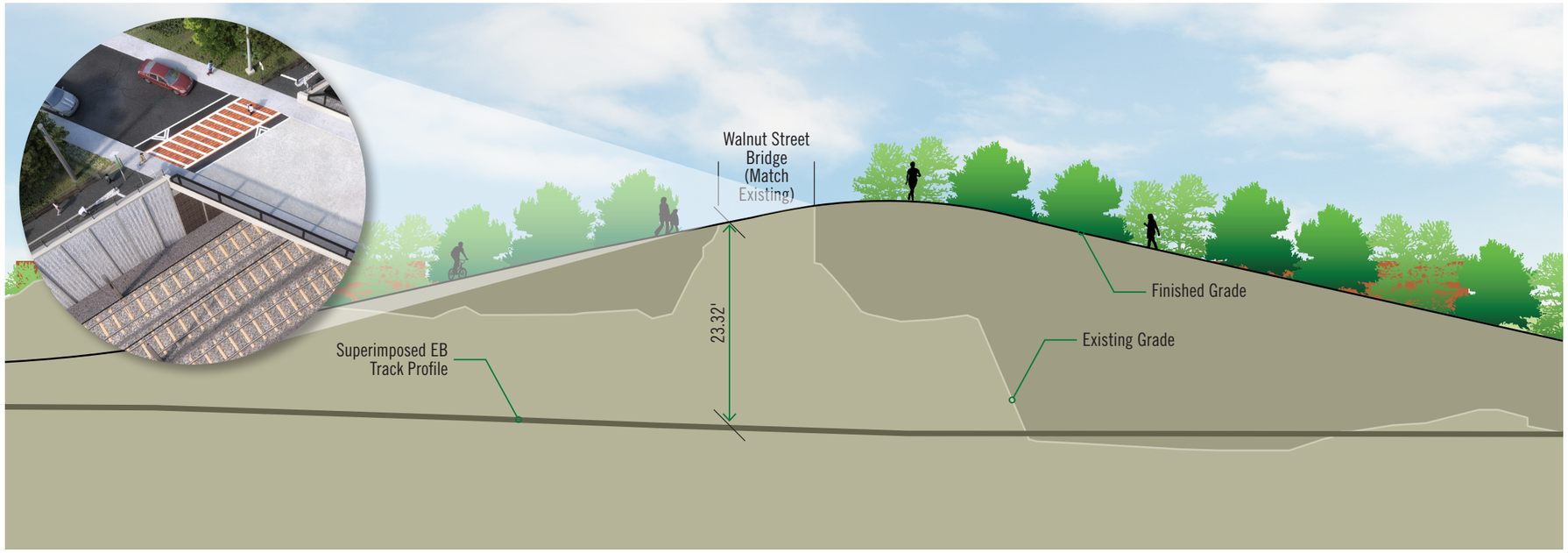
Foundations and site layouts for central instrument house:

- Located central instrument house to provide sufficient room for foundations and safe access

Traction power:

- **Traction power conduits and manholes for line feeds:** Identified locations and considered in the design
- **Traction power conduits and manholes for connection to the grid:** Identified locations and considered in the design
- **Foundations for overhead catenary system:** Identified location of overhead catenary system poles with sufficient room for appropriate foundations
- **Layout requirements:** Considered site layout requirements for the traction power substations

Figure 4.6-3 Community path redesign. WBG designed an at-grade crossing for the Community Path at Walnut Street to improve path access for the community. The design creates an additional access point, and improves visibility and safety by eliminating a pedestrian underpass.



B. CIVIL AND GUIDEWAY DRAWINGS

Continuous plan and profile alignment drawings along the GLX Project corridor are included with the Composite Drawings.

C. COMMUNITY PATH DRAWINGS

Continuous plan and profile drawings along the GLX Project corridor clearly defining the Community Path are included with the Composite Drawings.

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DRAINAGE AND STORMWATER MANAGEMENT

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.7 Drainage and Stormwater Management

WBG's stormwater management system will collect runoff and groundwater flows and comply with applicable federal, state, and municipal requirements, including permits related to stormwater management. The drainage facilities will result in a significant improvement over the existing system and provide additional treatment and control of stormwater discharges. WBG's relationships with the surrounding municipalities, and familiarity with their storm drainage and combined sewer system, make us well positioned to design the MBTA drainage systems and develop an effective stormwater management plan.

A. STORMWATER MANAGEMENT REQUIREMENTS

WBG has relationships with the both the City of Cambridge and City of Somerville Department of Public Works, as well as with the NorthPoint Development owners and designers. Based on this working relationship, WBG has a detailed understanding of the drainage systems in the two municipalities and the new development. This experience will help with our modeling efforts and development of the Stormwater Management Plan.

Approach to Stormwater Management Plans

WBG's hydraulic modeling efforts for the drainage design will be coordinated with the MBTA. This iterative process identifies design refinements required for the stormwater management system to function in accordance with the project requirements. WBG will keep the MBTA apprised of potential impacts that design changes may have on the existing or new drainage systems.

WBG has reviewed the January 2015 Stormwater Drainage Report for the Final Engineering Design (2015 SWDR), backup documents, and stormwater model files included in Appendix C of the 2015 SWDR. These models use either PCSWMM 2D software (a proprietary graphical user interface compatible with the U.S. EPA's Stormwater Management Model software), or HydroCAD software (a proprietary version of the Natural Resources Conservation Service (NRCS) TR-20 and TR-55 hydrology modeling software). The models are a reasonable representation of existing and proposed conditions. For the 2015 SWDR, the GLX Project was divided into five separate drainage area models, which include:

- College Avenue Area
- Gilman-Ball-Washington Street
- Union Square
- Millers River System
- Lechmere/NorthPoint

The model areas are shown in Figure 4.7-1. The HydroCAD software was used for the Lechmere/NorthPoint model and for quantifying runoff for the Washington Street roadway. PCSWMM was used for all other areas.

WBG's approach will be to combine the Gilman-Ball-Washington Street model with the Millers River System model, since the boundary between these two models is the critical Washington Street roadway. We believe that this model enhancement will facilitate the assessment of the drainage design in this critical flood-prone area. Additionally, we will convert the Lechmere/NorthPoint model to PCSWMM so that results can be more easily reviewed and presented. The models will be updated as needed to reflect design changes.

Drainage Elements Design Standard and Criteria

Subsequent to the issuance of the January 2015 GLX Stormwater Drainage Report, the project design criteria were updated as outlined in the Technical Provisions. Below are the most critical updated criteria related to stormwater system design:

- Maintain a maximum water level below the top of tie during the 50-year design event.

Figure 4.7-1 Project Overview.

- Maintain post-development stormwater discharge peak flow rates that do not exceed pre-development stormwater discharge peak flow rates, based on the design storms required by the municipality when tying into a municipal system.
- Design the Washington Street underpass for a 100-year event with a peak water surface elevation 12 inches above the roadway surface.
- City of Somerville: "No increase in runoff volume or rate at site boundaries."
- City of Medford: "Based on the NRCS 25-year design storm, such that peak discharge under proposed or future conditions flow does not exceed the peak discharge from existing conditions flow."
- Obtain a City of Cambridge storm water control permit. Stormwater runoff conveyed to the Charles River is subject to the requirements of the EPA Charles River Total Maximum Daily Load (TMDL) for phosphorus.
- Track underdrain invert elevation to be a minimum 3.5 feet below top of rail and horizontal alignment a minimum of 6.5 feet from track centerline.
- Underdrain pipe to be a minimum of 12 inches perforated HDPE
- Minimum 2 feet of cover from top of pipe to bottom of tie at locations crossing under the railroad tracks
- Pipe loading crossing under the tracks to be Copper E80

Storm Runoff

The proposed stormwater management facilities located within the GLX Project limits are composed of railroad underdrains, manholes, clean-outs, drain piping, two large pump stations (Washington Street and Red Bridge), one small pump station (Gilman Street), subsurface storage chambers, detention basin, infiltration trenches, hydrodynamic particle separators, and water quality filter units. Facilities installed to-date include structures for the large pump stations, the detention basin, and a limited number of underdrains and storm drains; however, none of these facilities are yet in service.

Several subsurface storage chambers are required to control peak flows from the rail corridor to comply with City of Somerville and City of Medford Stormwater Management Guidelines. These underground chambers have been identified in the 2015 SWDR document and are included in the various models at the discharge point from the rail corridor to the municipal system. As the design is revised and the hydraulic model updated, WBG will review the design of these subsurface chamber structures.

To meet the requirements of the City of Cambridge and the EPA Impaired Waters Program TMDL requirements for phosphorus to the Charles River, leaching trenches will be constructed in the Lechmere corridor in parking lots to be used for the GLX Project. Where infiltration is not feasible due to groundwater conditions, hydrodynamic particle separators and/or water quality filter units are planned to treat runoff prior to discharge to the municipal system. All these systems will be designed to treat the first inch of runoff, as required in the MassDEP Stormwater Management Standards.

Additionally, storage conduits have been constructed between the partially completed Washington Street pump station and the Red Bridge pump station. This storage conduit system is intended to reduce peak flows from the Washington Street area to the Millers River. As the model is updated with design changes, WBG will evaluate the effectiveness of these storage conduits. Currently, the storage provided meets City of Cambridge peak flow requirements.

A stormwater detention basin has also been constructed downstream of the Red Bridge pump station. WBG will evaluate the operation of the detention basin and provide design updates if required. Currently, the storage meets the peak flow requirements of the City of Cambridge.

The storm drainage system is designed to convey runoff for the future station expansion. Therefore, no design changes will be required if the stations are extended to the 300-foot length.

Key Drainage Issues by Location

WBG has identified several key drainage issues at various locations. Below is our approach to addressing these issues in the design.

Proposed Stations

As part of our hydraulic modeling efforts, WBG determined elimination of underground platform stormwater storage chambers associated with the proposed stations did not have an adverse impact on the stormwater design. The storage units provided minimal storage and were modeled to reach capacity prior to the peak of the design storm. Therefore, we do not need underground platform stormwater storage.

College Avenue Area

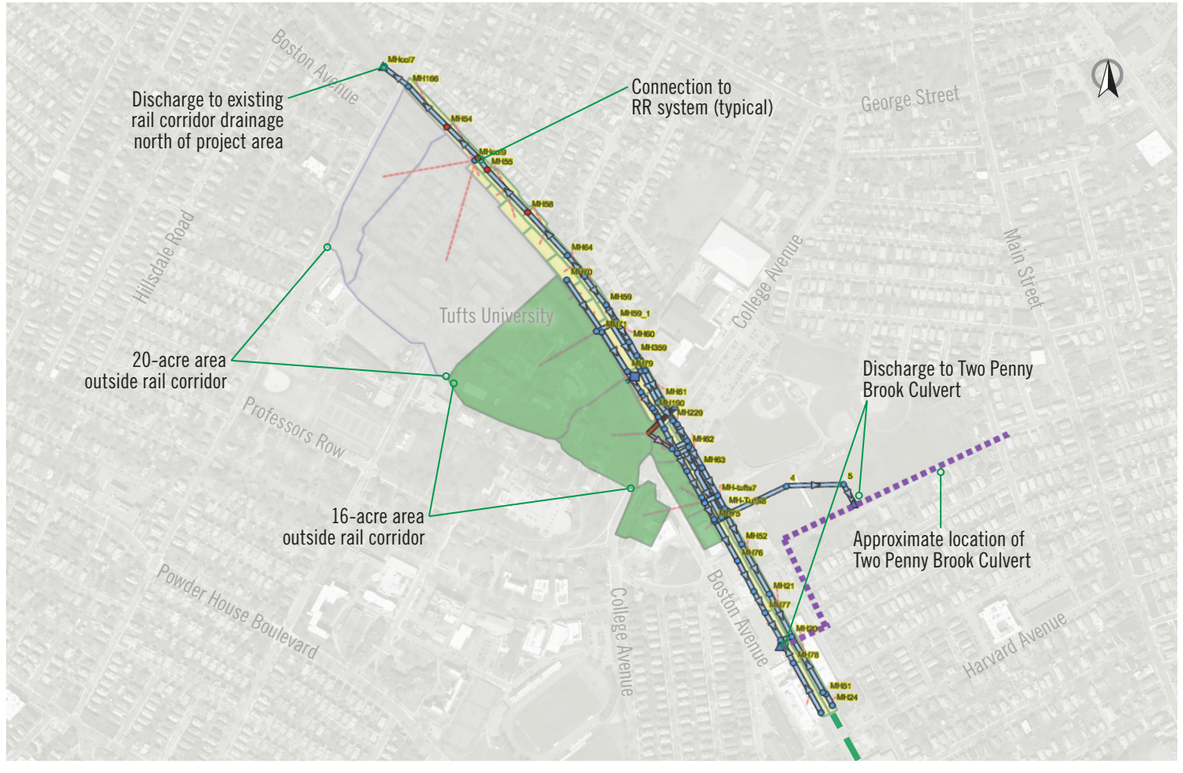
WBG understands the MBTA's long-term objective to extend Green Line service to Route 16 (Mystic Valley Parkway) in Medford. The extension from College Avenue Station to Route 16 is the subject of a Notice of Project Change filed in January 2017. MEPA review is currently in progress, and this extended section of Green Line track is under consideration. Funding and right-of-way challenges along the corridor are primary topics of discussion. The College Avenue watershed model is shown in Figure 4.7-2.

Based on our detailed review of existing RFP documents, as well as the stormwater drainage models for the project, the rail corridor west of the proposed College Avenue Station experiences major flooding due to off-site stormwater flows from upland areas of the Tufts University campus south of Boston Avenue. Stormwater flow from the campus area is diverted into the existing rail corridor and below the tracks at two specific locations.

In the first location, the model includes a 48-inch-diameter drain that the drawings indicate will be installed by Tufts University. The plans only include the portion of this drain within the rail corridor. If the downstream storm drain is not installed by Tufts, this could result in significant flooding in the rail corridor during the design storm.

At a second location, as shown in the RFP documents, upland flow from the City of Medford connects to an existing, undersized sub-drain system at the end of the project where the proposed track system meets the existing commuter rail tracks. The model, as received, includes a 13-foot-wide by 1.5-foot-deep open trench drain to convey flow north toward Winthrop Street. Currently, there are no plans to construct this trench drain. When the trench drain is removed from the model, flooding is predicted in the area between the City of Medford pipe connection and the Winthrop Street bridge above the top of tie.

Figure 4.7-2 College Avenue Watershed.



A natural breakpoint exists in this section of the proposed drain system, where stormwater flows are diverted westerly toward the Winthrop Street Bridge. WBG recommends that the ultimate solution to this flooding issue is included in the design for the Green Line Extension to Route 16 (Mystic Valley Parkway), when the commuter rail corridor is expanded to allow for a 4-track system. Constructing an open trench or subsurface detention boxes in this area is not practical, since the amount of off-site stormwater flow will greatly exceed the capacity of any proposed mitigation measures to eliminate or reduce flooding above the top of tie during the design storm event. Severe right-of-way constraints also contribute to the inability to provide effective stormwater treatment measures.

Model-predicted flooding locations are shown for College Avenue in Figure 4.7-3.

Union Square Area

The existing underdrain serving the commuter rail between Stations 103+00 to 105+50 (west end of watershed) is predicted to flood during a 50-year design storm. Flooding is a result of relatively low ground surfaces and high tailwater conditions in the downstream Somerville combined sewer system. The total volume of flooding is predicted to be approximately 0.5 acre-feet, which would result in an average depth of 6 inches over the estimated flooding area. The Union Square watershed model is shown in Figure 4.7-4.

The proposed underdrain between FLT1 98+00+ to FLT1 104+10+ should be modified to reduce the depth and duration of flooding in the existing underdrain. We recommend evaluating alternative alignments during final design. The underdrain should potentially be installed from proposed MH302_1 to existing USMH1 or USMH2. This re-routing of the proposed underdrain for the Green Line tracks will reduce the flow in the existing underdrain serving the commuter rail, which is predicted to flood during the design storm.

Gilman-Ball-Washington

The 2015 SWDR stated that the low-pressure storage conduit near Gilman Station would only be dewatered for maintenance and inspection. However, we believe that the storage conduit should be dewatered between storms to provide in-system storage. This final recommended size of the storage conduit is 60-inch FRP. The current proposed design meets the requirement of no flooding above the top of tie during a 50-year storm. The Gilman-Ball-Washington watershed model is shown in Figure 4.7-5 on page 4-93.

Millers River

The current proposed design meets the requirement of no flooding above the top of tie during a 50-year storm. However, further investigation of the drainage system for the Vehicle Maintenance Facility is required as the final design for this facility has not yet been incorporated into the model. The Millers River watershed model is shown in Figure 4.7-6 on page 4-93.

Lechmere

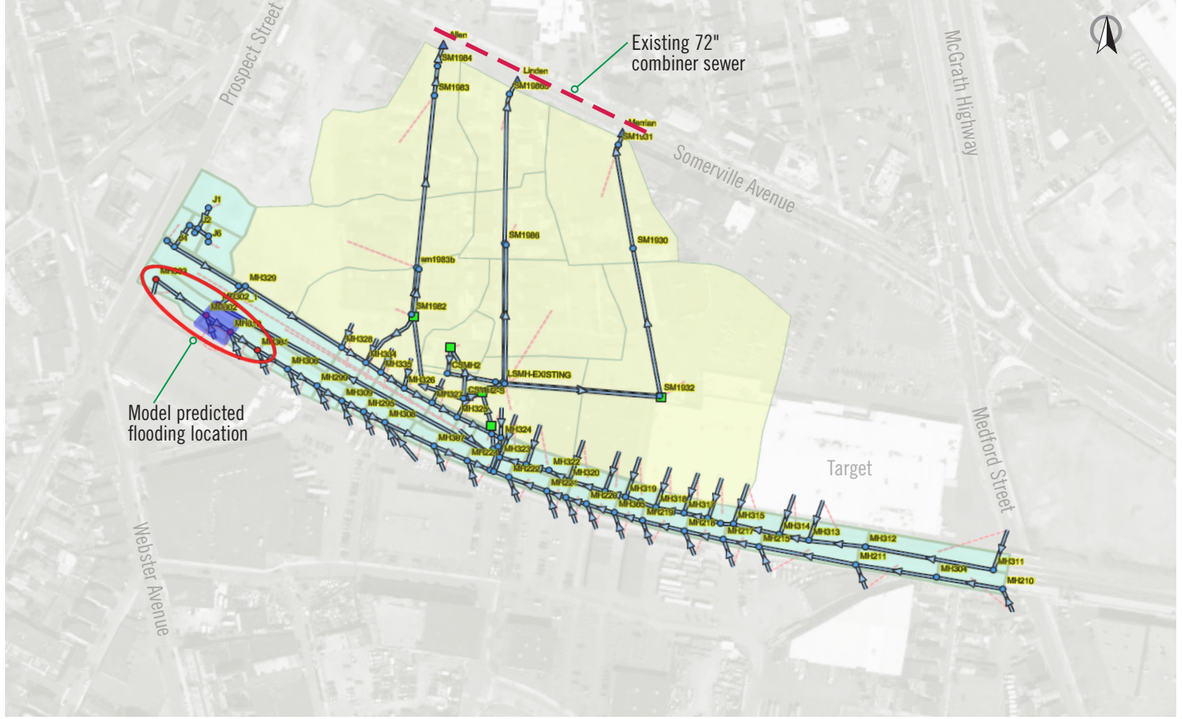
The current proposed design meets the City of Cambridge requirements for 18 inches of freeboard during the 25-year NRCS design storm. Flooding of the tracks during the 50-year storm is not an issue with the elevated viaduct in this watershed.

Millers River Drainage Outfall

The GLX Project requirements include the cleaning of three existing 48-inch RCP drain pipes and an existing 72-inch RCP drain pipe that eventually convey stormwater flow into the Millers River as shown in Volume 2 – Civil of the RFP documents. Drawings 000-C-0019 and 000-C-0020 of the Union Square Branch Drainage Layout provide the extent of the work. Roadway Discipline Design

Figure 4.7-3 College Avenue Flooding.

Figure 4.7-4 Union Square Watershed Model.



Lead Rick Azzalina is familiar with these pipes and the effort required to inspect and clean them, based on his prior Central Artery experience as an authorized representative for the area north of Causeway Street. Rick led the joint venture design team for the Charles River Crossing and Leverett Connector B and later served in the resident engineer's field office during construction. He understands the area's challenges and the solutions that proved to be successful, and will be a knowledgeable resource for WBG's drainage team.

The water level in the lower Charles River and in the Millers River, once tidal, is controlled by the Charles River Dam downstream of the outfalls. For years, outfall pipes into the Millers River have been subjected to submerged conditions (such as pipe inverts significantly lower than the Charles River Basin water level) and a constant buildup of sediment with little to no flushing action typically associated with tidal fluctuations. As a result, inspection and cleaning any existing lengths of drain pipe to remain in the Millers River Watershed Area is imperative, particularly those that are major components of the overall system.

The work will entail construction of a temporary bulkhead in the Millers River and a series of temporary bypass pumping installations to adequately inspect and clean the pipes. A specialized subcontracting firm, experienced in this type of work, will oversee the video inspection and cleaning of all existing drain pipes to remain. This same approach was successfully used for the inspection and cleaning of the main drain which currently serves the double-decked, elevated section of I-93, the Leverett Connector, and the MBTA Orange Line Rail Corridor.

Drainage System and Appurtenances

The pressure drain will convey flow from two large storm drains north of the Gilman Station approximately 2,200 feet to the Gilman Station area. A small pump station is required to dewater this pipe between storms, which will provide some in-line storage in this system. The drain was originally designed because the track in the area was lowered, requiring the replacement of existing storm drain with a deeper conduit that could not drain by gravity (requiring the pump station). The final recommended size of the storage conduit is 60-inch FRP. WBG's current proposed design meets the requirements of no flooding above the top of tie during a 50-year storm.

The previously constructed detention basin located near the Red Bridge traction power substation will store peak flows pumped into it from the Red Bridge pump station. The outlet control structure will slowly release stored flows back into the drainage system tributary to the Millers River. Preliminary modeling suggests that this detention basin is adequately sized for the 50-year design storm.

The Washington Street pump station will pump all its flow into an in-line storage system. The purpose of this in-line storage is to attenuate the peaks from the Washington Street pump station, and avoid overwhelming the downstream system. Previously, the flow from Washington Street was conveyed to the Millers River system. These pipes have all been partially constructed and preliminary modeling suggests that they are adequately sized to convey the 50-year design storm.

The Washington Street and Red Bridge pump station structures have both been installed. Pumps and appurtenances associated with Red Bridge have all been purchased and are on-site. Preliminary modeling suggests that these two pump stations are adequately sized to convey the 50-year storm event.

B. STORMWATER MANAGEMENT DRAWINGS

Stormwater management drawings are provided with the Composite Drawings.

Figure 4.7-5 Gilman-Ball-Washington Watershed Model.

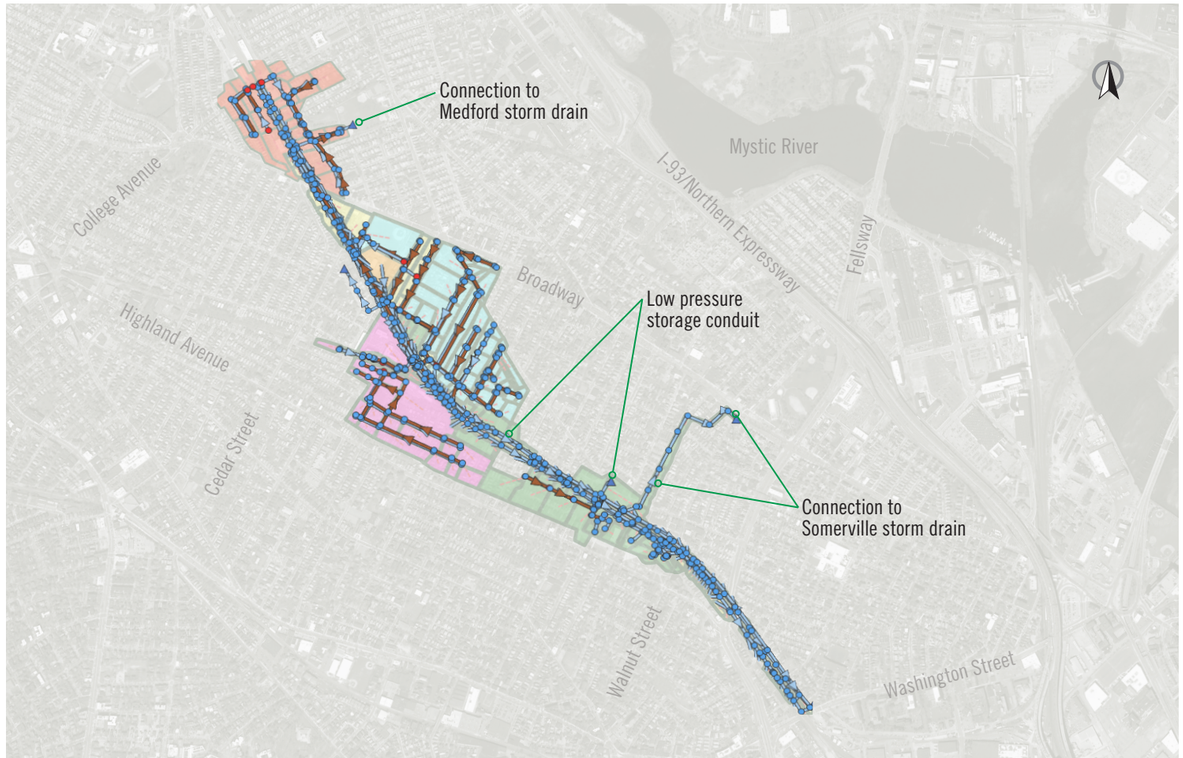
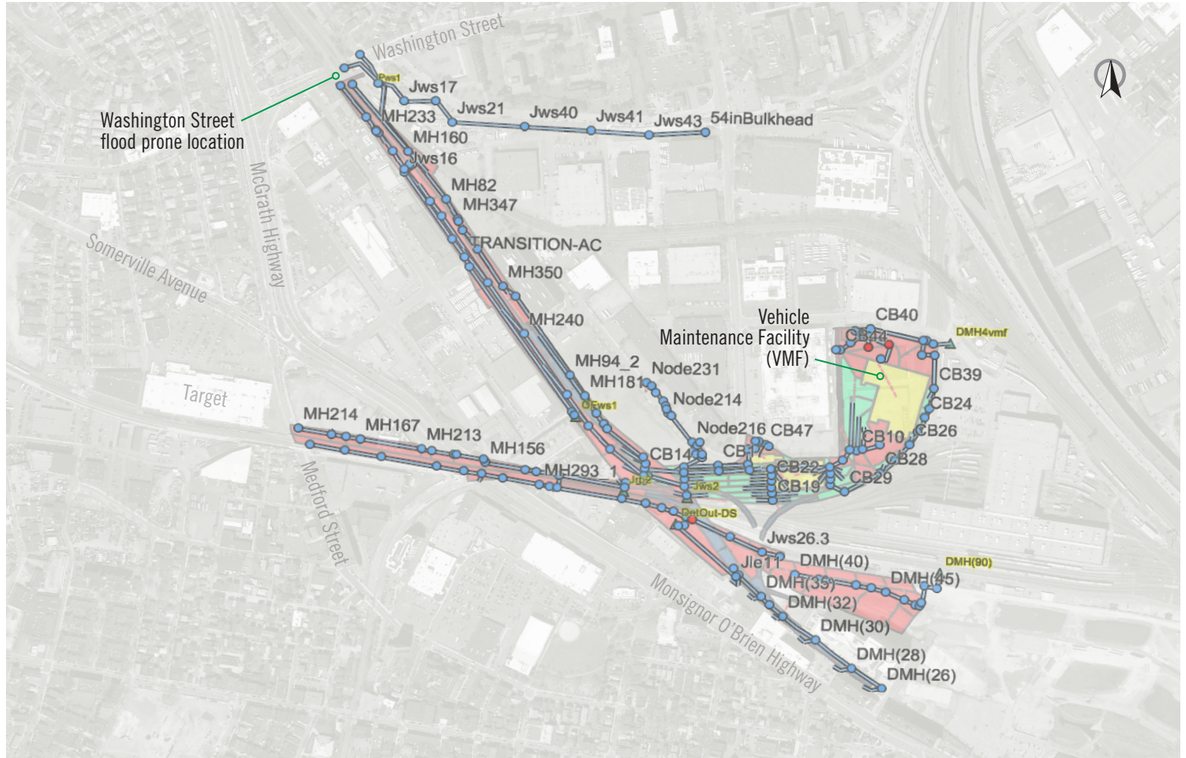
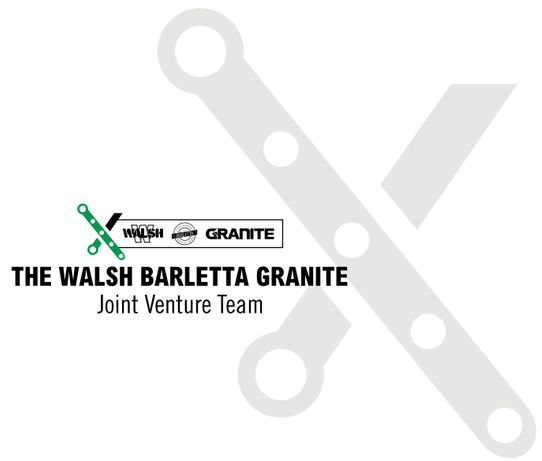


Figure 4.7-6 Millers River Watershed Model.



ENVIRONMENTAL MANAGEMENT STRATEGY



THE WALSH BARLETTA GRANITE
Joint Venture Team

4.8 Environmental Management Strategy

WBG understands that the MBTA's environmental concerns focus on the proper treatment and disposal of contaminated water and soils. Of equal importance is a comprehensive and transparent environmental program led by WBG that ensures abutters and community residents consider the GLX to be a "good neighbor." Through face-to-face communication with local residents, we will implement strategies that achieve this vision.

A. ENVIRONMENTAL TEAM

WBG will assign a full time Environmental Compliance Manager (ECM), Patrick Cornell, who will work closely with both design and construction personnel. The ECM will report directly to the Executive Committee to ensure independent reporting of all environmental-related issues. He will maintain daily communication with the Project Manager and Construction Manager, as shown in Figure 4.8-1.

For design, our ECM will have a direct contact at Jacobs who will review all design elements for potential environmental impacts and ensure full compliance with the commitments made in both the MEPA Draft 61 and the FONSI. For field operations, the ECM will have direct reporting from the personnel assigned to the day-to-day management of operations associated with landscape tracking, noise and vibration monitoring, asbestos and lead abatement, and salvage and recycling efforts. The ECM will be supported by the Licensed Site Professional (LSP), Joseph Salvetti of Stantec. Joe will be available for the Project from design through final completion.

For short-term work items, such as those associated with demolition, WBG will assign a licensed lead inspector and/or asbestos abatement inspectors, both of whom will be provided by our fully licensed specialty subcontractor(s). For long-term tasks associated with waste management, including excavated soil management, the handling and disposal of contaminated materials and waters, recycling of landscaping waste, mitigating airborne particulate matter, monitoring noise and vibration, and implementing the comprehensive plans required for this project, Patrick will be assisted by Joe and independent environmental engineers that will monitor our construction operation compliance with environmental commitments.

The asbestos abatement inspector and/or lead abatement inspector responsibilities will include:

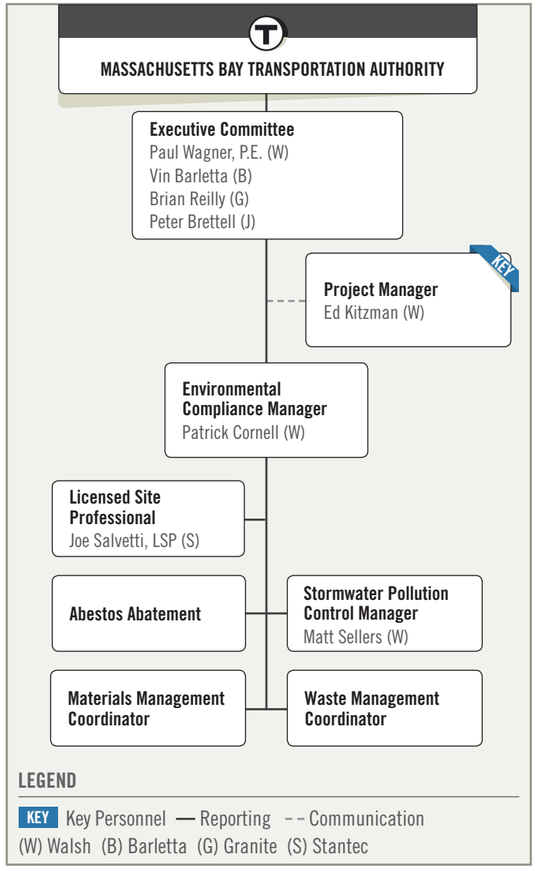
- Quantify the materials to be encountered
- Formulate and receive approval for mitigation plan
- Ensure the training, qualifications, and protocols are in place and strictly complied with by the individuals performing the work
- Maintain all necessary documentation as to the proper classification and final disposal of hazardous materials

The environmental engineers and environmental monitoring inspectors responsibilities will include the following:

- Assist with the development of the Comprehensive Environmental Protection Program (CEPP) and the associated environmental mitigation monitoring plan
- Establish and implement a comprehensive program with our excavation team to do in-situ testing and pre-classification of the soils to be excavated on the Project
- Provide training to WBG field staff on all aspects of awareness and monitoring requirements for noise, vibration, and contamination
- Monitor and provide weekly and monthly environmental monitoring reports, including monitoring methodology and reporting from WBG site forces on construction and demolition waste management plan, landscaping tracking plan, and noise and vibration monitoring plans

In addition, WBG's environmental team will include a Materials Management Coordinator, a Waste Management Coordinator, and a Storm Water Pollution Manager who report to the ECM. Their responsibilities are described later in this section.

Figure 4.8-1 GLX environmental team organization chart.



Licensed Site Professional
Joe Salvetti

Joe currently serves as LSP to the Patrick/HMM Red Line Orange Line infrastructure improvements team, providing oversight of soil management and Massachussetts Contingency Plan (MCP) regulatory compliance. He will assist ECM Patrick Cornell in daily monitoring and remediation of environmental issues throughout the GLX site.

B. ENVIRONMENTAL PROTECTION PLANS AND CONTINGENCY PLANS

WBG will develop the necessary environmental protection plans and associated contingency plans to fully comply with the MBTA's Project environmental commitments, as identified in the MEPA Draft Section 61 Finding and the Federal Transit Administration's FONSI.

Our CEPP is the overarching plan we will use to ensure that commitments made during the environmental approval and permitting process, and other environmental requirements, are reflected in the design and implemented throughout all Project phases.

The CEPP will include eleven individual environmental plans:

1. Environmental Mitigation and Monitoring Plan (EMP)
2. Environmental Protection Training Plan
3. Construction Noise Mitigation Plan
4. Storm Water Pollution Prevention Plan
5. Construction and Demolition Waste Management Plan (CDWMP)
6. Excavated Materials Management Plan (EMMP)
7. Noise and Vibration Mitigation Plan (NVMP)
8. Hazardous Waste Management Plan
9. Landscape Tracking Plan
10. Construction Indoor Air Quality Management Plan
11. Integrated Pest Management Plan

These plans outline environmental issues and detail how we will ensure that our workforce is aware of, and trained in, Project commitments to ensure that all our work occurs in a manner that is considerate to the environment while simultaneously minimizing impacts to the area surrounding our construction activities.

Within the CEPP, WBG will detail our goals and procedures for mitigating environmental impacts, while also providing details of our planned tracking methodology and reporting structures. WBG will also include information on violation reporting and issue response plans. In addition to the CEPP, WBG will provide the MBTA with required and requested plans for other specific topics to ensure WBG mitigates environmental impacts to the highest extent possible.

Through a variety of procedures, WBG will have in place comprehensive plans that ensure the most appropriate, efficient, and sustainable methods and equipment necessary are used. In addition, WBG will be able to track and receive documentary evidence of off-site recycling of Project-generated materials.

C. ENVIRONMENTAL COMMITMENTS AND AGREEMENTS

WBG is keenly aware of the MBTA's environmental commitments and agreements reached after thorough evaluation of the right-of-way and analysis of Project impacts on the surrounding community. WBG will assess all the requirements of the MEPA Draft Section 61 findings and the FONSI during both design and construction to ensure that all commitments are in full compliance. A summary of WBG's environmental strategy is shown in Figure 4.8-2.

During the early design phase, WBG evaluated processes and procedures that allow completion of all required non-exclusive deliverables within the timeframes required under Volume 2, Section 3.4. To complete these deliverables within the timeframes, WBG will assign qualified resources from design, construction management, and field supervision. They will ensure the deliverables fulfill all commitments and are tailored to our work plans.

For the environmental commitments regarding revenue service impacts from the Project, our approach will be two-fold. First, the design team will review all accumulated analysis data that the MBTA has generated and incorporate it into our designs as necessary. Second, we will supplement that information with field data where design revisions or time-sensitive data require. This approach is relevant to noise barrier designs, as changes in this portion of the work have occurred due to minor grade and alignment revisions.

WBG's work plans will include environmental mitigation. As detailed further in this section, we developed a logical and sequential approach to handling environmental commitments associated with soils, water, and landscaping debris. We will accomplish this using proper tools, equipment, and planning that minimizes, dust, noise, and vibration impacts to the community. We will also prosecute the work in a sequence that allows us to complete geographical areas and reduce our overall construction footprint as rapidly as possible, restoring the areas to the community.

To demonstrate our commitment to environmental management, WBG will prioritize training our project personnel. Training will include environmental tools and procedures to deepen our commitment to sustainability.

D. ENVIRONMENTAL MONITORING, INSPECTION, AND REPORTING

The WBG team will include independent environmental monitoring inspectors with the qualifications and training to ensure compliance with environmental approvals and hazardous materials management. They will perform site monitoring inspections, including random field verification testing, such as noise and dust monitoring, review all Project-generated environmental reports to ensure accurate and timely reporting, and assist the ECM in training and issue resolution. Joe will oversee compliance associated with soil and groundwater management within MCP disposal sites. A soil and groundwater pre-characterization plan will include soil and groundwater analytical testing. Licensed inspectors will be responsible for implementing and documenting lead and asbestos abatement.

Figure 4.8-2 WBG's environmental management strategy.

PLAN
Create and Adhere to Required Environmental Plans: Implement employee training, monitoring, documentation, and reporting.
Implement Sustainability: Use recycled building materials and reuse soils on site.
Do No Harm: Exercise care during excavation/earthwork.
Limit Removal of Material from Site: Re-use material on GLX alignment.
Exercise Extreme Care at Known Contaminated Areas: Areas include 50 Tufts Street, Union Square, and Northpoint development.
Be A Good Neighbor: Implement public outreach program and mitigate dust, air, noise, vibration, and light pollution during construction.
Apply Stand-Alone Environmental Organization: Environmental organization is independent of cost and schedule and reports directly to WBG Executive Committee.
Implement Indoor Air Quality: Design indoor air quality into VMF and monitor during construction.

Field staff trained in the use of portable instrumentation and media sampling will be on-site during compliance monitoring activities. This includes sample collection for appropriate laboratory analysis during soil excavation and groundwater dewatering at contaminated sites. Dust monitoring will be performed during excavation and soil stockpiling activities. Appropriate quality assurance and quality control will be documented in monitoring reports.

E. MANAGEMENT AND HANDLING OF CONTAMINATED MATERIALS

Joe will oversee the management of materials encountered at any of the MCP sites. Soil will either be reused on-site or transported to a licensed disposal facility. Contaminated groundwater will be treated and discharged according to RFP requirements. A soil and groundwater pre-characterization plan will be used to identify areas where special handling of soils and groundwater may be required due to the presence of contaminants not associated with existing MCP sites. Specific soil management plans will be developed for 21 and 22 Water Street, Washington Street utilities, Ball Square Station, Union Square Station, the VMF, Gilman Square, and 137 Washington Street in Somerville.

WBG is fully aware of the MBTA's efforts to analyze the Project site and provide soil classification information in the reports provided in Section 16 – Environmental of the RIDs. WBG will work in a fashion similar to Kleinfelder to ensure all soils along the alignment are subjected to in-situ testing and classification. The soil classification matrix and project mapping will be an invaluable tool to identify the materials and determine proper handling and disposal processes.

If impacted soil/groundwater is identified outside of the known site boundaries, Joe will apply current MCP guidance and regulations to manage these materials.

F. EXCAVATED SOIL MANAGEMENT

WBG will prepare a comprehensive EMMP, overseen by the Materials Management Coordinator, describing our approach to handling excavated materials and review the site information provided in the RFP documents with specific emphasis on known areas of concern, namely the key MCP sites and the related release tracking numbers (RTNs) that identify areas of hazardous materials, groundwater contamination, and heightened concerns.

The EMMP will include a graphical representation of the entire Project with each excavation and stockpile area identified. Additionally, individual zone handling maps will identify the zone's excavation, assigned haul route, and material stockpile area or direct disposal location. This will be accompanied by a single-page oversight excavation-to-disposal site tabulation for easy field reference. The EMMP will detail daily excavation records, stock pile receipt logs, and off-site final disposal records, along with in-office detailed reports of daily and cumulative excavation/reuse and disposal tracking data.

The EMMP will define the means and methods for quantifying and identifying the material excavated daily, from point of excavation to the assigned stockpile or disposal location, for tracking purposes. Logs for all excavation work will be turned in separately from the excavation and receiving location. All input records will be cross-checked the next business day to ensure accurate inventories are in place. All data will be maintained in a database to provide monthly update reports for submission to the MBTA.

The EMMP will be updated to identify the current and available source of material via "Backfill Zone" maps. For all backfilling operations on the Project, the tracking system will remain the same as for excavation operations, wherein both source and receiver will track each movement of material and the data and documentation will be reviewed daily for accuracy and verification.

Since the MBTA is using the e-Builder system for this Project, we envision that they will have full electronic access to items such as daily records, transport logs, and current stockpiled inventory.

G. MINIMIZING NOISE AND VIBRATION IMPACTS

WBG recognizes the Project's proximity to densely populated residential areas and several schools. This requires sensitivity to noise and vibration impacts from construction. We will prepare a comprehensive NVMP tailored to WBG's equipment and methods of construction.

In developing our final design, work sequencing, and the methods to perform work, WBG will include updated, non-disruptive practices. The NVMP will address specific equipment and methods of construction. Key focus points are:

- » Move stationary construction equipment to where noise levels will have the least impact or use noise reducing enclosures
- » Minimize nighttime construction operations
- » Analyze work operations for noise impacts prior to commencement and monitor operations to ensure noise impacts are minimized

To achieve these goals, WBG will identify the means and methods to be employed, including mandatory noise equipment certification testing, specially quieted equipment with fully enclosed engines or high-performance mufflers, strictly enforcing a "no idling" policy, installing temporary noise barriers or acoustic panels for noise intensive work operations, and developing truck routes that minimize exposure to the surrounding residential areas.

The NVMP will detail protocols to report noise monitoring results, noise reduction measures, and responses to community questions through the Project hotline. The ECM will implement these protocols and be responsible for ensuring noise levels are monitored regularly throughout the Project. Corrective actions will be implemented if any exceedances are observed, and all community noise or vibration complaints will be formally documented to the MBTA within seven days of occurrence. Weekly reports will be compiled into monthly and cumulative Project records for all NVMP requirements.

KEY ITEMS TO MINIMIZE NOISE AND VIBRATION IMPACTS

NO IDLING POLICY
Implement strict no idling policy to reduce noise pollution, reduce air pollution, and promote energy conservation

MINIMIZE NIGHTTIME CONSTRUCTION
Minimize nighttime construction operations between the hours of 10 PM and 7 AM to adhere to Noise Control Plan

NOISE REDUCING MATERIALS
Use noise deadening materials on chutes and bins

ACOUSTIC SHIELDS
Use acoustic shield for noise intensive work operations to reduce noise through sound barrier and noise absorption

COMPRESSOR INTAKE AND PNEUMATIC EXHAUST SILENCERS
Use equipment furnished with compressor intake silencers and pneumatic exhaust silencers to reduce mechanical noise and increase equipment efficiency

H. AIRBORNE PARTICULATE MATTER

WBG will minimize and mitigate dust generation throughout the Project. This includes strict management of soil stockpiles and excavation. WBG will ensure that run-off from wet down operations at stockpiles are properly contained through sloping, perimeter erosion control measures, and maintenance of settlement ponds. Traffic along roadways will also be monitored to mitigate dust generation through water misting or use of calcium chloride, as determined by weather conditions. WBG will use street sweepers and washers to aid in dust mitigation. Vehicle wash-down pads and equipment decontamination pads will be used to limit the off-site spread of impacted soils near vicinity roadways and neighborhoods. The EMP will detail the measures to be taken to construct and manage the vehicle washing areas.

I. SALVAGE/RECYCLING

WBG will develop and implement a CDWMP and a Landscaping Tracking Plan, which will detail the team's commitments and detailed procedures for on-site salvage/recycling measures to meet the Project goals of salvage/recycling at least 90% by weight of total nonhazardous solid construction and demolition waste and at least 80% of all hazardous or contaminated waste material that can be recycled. For example, we are planning to reuse physical track and railroad ties whenever the condition of the materials warrant.

The CDWMP goals will be prominently included in solicitations and in final agreements with subcontractors and suppliers and will include mandatory training for all on-site employees. Project personnel training will discuss our commitment to salvage and recycling and implementation of our sustainability program.

Noise Mitigation Measures. While working in downtown New Orleans on the Loyola Streetcar Project, WBG partner Walsh used sound shields to avoid noise disruptions next to businesses.

For on-site excavation operations, WBG will work in compliance with our Project-specific EMP and a Hazardous Waste Management Plan to maximize material reuse on-site and reincorporate hazardous soils/ballast materials into the Project works. These plans will work in unison to track all areas of material excavation, stockpiling, and backfill. On a continuing basis, the data will be evaluated for effectiveness, methods for future improvements, such as ensuring maximum material use occurs on-site with the least amount of rehandling. WBG will comply with the Historic Properties requirements to preserve a dedicated portion of the Lechmere viaduct for historical restoration and reincorporation into the work. Through these efforts, WBG will ensure that direct recycling of material will be promptly completed and verifiable.

J. LANDSCAPING WASTE

WBG will assign a landscape management coordinator to develop and implement a Landscape Tracking Plan focused on sustainability. Our goal is to divert as much material from landscape waste away from landfills or incineration into reuse/composting with a target of at least 90% for landscape waste and 50% for landscape soils as reuse within the Project limits or off-site. WBG's clearing and grubbing subcontractor will take this material off-site and deliver it to an industrial composting site. Topsoil will be reused on-site.

Clearing and grubbing operations will be performed on a schedule that places removals just in advance of major earthwork along the alignment, and uses on-site mulching and composting. We will use materials that are appropriate for the season on final landscaping/grading operations.

K. TRAINING ON WASTE MANAGEMENT PROCEDURES

The CDWMP's goal is to maximize the amount of recycled materials from demolition and construction. To educate our crews, subcontractors, and suppliers on WBG's waste management goals, we will take the following steps during procurement.

1. Comprehensive pre-employment training that includes a stand-alone segment on the CDWMP to identify the plan's goals and the methods to reach them. This training will include the Waste Management Coordinator's contact information should further information be required or to report abuses of the policy. Continuing education on this topic will occur as work progresses.
2. Include requirements for suppliers that clearly delineate our waste management approach. We will require them to affirmatively respond with all necessary information to:
   - Use maximum recyclable packaging content for the components provided to the Project
   - Reclaim and reuse packaging in its entirety
   - Follow specific recycling methods for non-standard packaging
3. Include subcontractor requirements that clearly define our waste management approach and on-site mandatory recycling procedures. In addition, subcontract agreements will require that specialized contractors with unique waste generation commit to establishing a specific recycling plan for their materials with a 90% recycled waste goal.

L. CONSTRUCTION INDOOR AIR QUALITY

WBG will develop a Construction Indoor Air Quality Management Plan, in accordance with the technical provisions and with the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction ANSI/SMACNA 008-2008 (Chapter 3) standards.

Provisions will include the use of handheld monitoring devices to ensure indoor air quality during construction and demolition.

M. INDOOR AIR QUALITY IN NEW BUILDINGS

In accordance with the International Energy Conservation Code (IECC), and the International Mechanical Code IMC), we will provide the following Indoor Air Quality (IAQ) elements:

- » Meet minimum outdoor air ventilation rates for people and air change requirements
- » Filter air supply into buildings
- » Pressurize occupied spaces in a building to improve air quality using additional air pumped into buildings to minimize the infiltration of unconditioned outdoor air

Indoor air quality standards for new buildings will be applied to the following locations: Vehicle Maintenance Building, Transportation Building, traction power substations, pump stations, and any applicable enclosed rooms at the new stations.

N. PRE-PURCHASED EQUIPMENT AND MATERIALS

WBG understands the investment the MBTA has made in raw and manufactured components for the Project. To maximize their use, WBG is committed to maintaining the structural steel investments made for the viaduct and the Washington Street bridge, and will refine the existing designs after ensuring full compliance with all applicable standards and contract requirements.

We will evaluate equipment that the MBTA has in storage to ensure it meets all requirements of the contract for operational readiness and warranty requirements. Should we determine that manufacturer recertification or recalibration is necessary and economically appropriate, WBG do so to minimize cost while providing a fully functional end use installation.

O. BUILDING COMMISSIONING FOR LIGHTING, HVAC, HOT WATER, AND RENEWABLE ENERGY

Section C408 of the IECC requires building electrical power and lighting systems and commissioning mechanical and plumbing systems. This includes air and water balancing to meet design and operational requirements and functional and performance testing of equipment and fixtures. HVAC and service water heating control systems will be tested to document that control devices, components, equipment, and systems are calibrated and adjusted to operate in accordance with plans and specifications. Sequenced HVAC system operation and equipment will be functionally tested for compliance.

P. STORING COMPONENTS

Within the CEPP, there will be a section detailing WBG's approach to storing components for the work (Figure 4.8-3).

All subcontractors and suppliers will be required, by the terms of their agreements, to assign one of the designated storage requirements to all their component parts. Quality personnel will perform material receipt inspections of on-site Project materials and will include information on material storage on daily inspection forms.

Designated material storage locations will be thoroughly inspected on a weekly basis and any variations from the recommended storage methods will be immediately rectified. Actions taken will be described in the QC inspector's daily inspection form. Proper material storage and handling will be included in employee orientation training.

Q. LANDSCAPING SPECIES

WBG will prepare an overall plant matrix including deciduous, ornamental and evergreen trees, deciduous and evergreen shrubs, and ground cover. Criteria will include each plant's native status, drought-tolerance, salt-tolerance, tolerance of heat and water, non-invasive status, USDA zones, and mature plant characteristics such as height, width, flower, bark, fall color, and maintenance issues. Each plant needs to thrive without irrigation and fertilizer after the establishment period. The plants for each station or location will be selected from this matrix, using sound design principles for specific sites such as solar orientation, wind, slopes, proximity to fences, walls or pedestrians, and aesthetic goals. The availability of the selected plant species will be assessed during the design phase. This region is experiencing a shortage of high quality, large-sized trees and shrubs and WBG will seek them early in the Project to secure the appropriate plant stock.

R. WILDLIFE HABITAT

WBG expects minimal wildlife habitat along the GLX corridor. To mitigate the level of disruption to wildlife, WBG will ensure clearing operations in the Project Schedule occur near active construction operations along each area of the Project.

To minimize the overall impact to the natural wildlife habitat, WBG plans to perform restoration and landscaping work immediately following the completion of major operations within each area, provided weather and physical conditions allow. By planting appropriate trees, shrubs, groundcover, and wildflowers as soon as practical, WBG will restore the natural habitat that will attract birds, bees, and butterflies. WBG will ensure that the landscaping type will allow for nesting areas, along with food and water accessibility throughout the Project, without creating any water ponding or maintenance areas.

S. PEST SUPPRESSION AND PREVENTION

Pest deterrence is not isolated to construction and will be addressed in final design. The design will detail appropriate measures to mitigate pest roosting such as angling abutting walls, grading pitches to drainage points, bird control spikes, bird prevention screening, and eliminating overhangs/sheltered voids.

Before work begins, a pest control specialist will perform a site reconnaissance and evaluation of the potential effects of pest displacement and migration. From this evaluation, we will develop and layout in detail the types and locations of pest habitats and the likely points of migration. With this information in hand, we will develop and implement a treatment monitoring plan that identifies specific proposed locations for baiting and trapping, the minimum pest monitoring radius, and the proximity of significant facilities such as schools, daycares, hospitals, and fast-food restaurants.

WBG will seek local municipality input on known hot spots and pest control complaint areas and share our approach with these officials. Pest complaints will be addressed through the Project hotline.

WBG will submit an Integrated Pest Management Plan within 10 working days of receipt of NTP. The plan will detail our best management practices and the appropriate balance between utilization of advanced technology and proven practices.

During construction, our workforce will be proactive in maintaining a clean work environment to minimize potential new nesting locations. Standard measures employed include spring loaded covers on refuse containers, daily policing of work areas for trash, prompt disposal of construction debris, proper stacking and spacing of stored materials, and frequent weeding/vegetation control.

T. OUTDOOR LIGHTING

Lighting controls for all exterior site areas will be installed as described in the first paragraph of Technical Provision 13.5.3. Outdoor lighting will be controlled by lighting control panels with integral programmable controllers and interface with photocells to turn lights on/off and dim up to 80% at night to reduce energy use.

Figure 4.8-3 GLX Material Storage Classifications

STORAGE LEVEL	THE WBG STORAGE APPROACH
A	» Seek indoor, secure, and well-ventilated building or equivalent enclosure (including storage trailers) » Ensure paved or well-drained floor to eliminate flooding » Ensure uniform heating and temperature control, minimum 50°F and maximum 90°F » Maintain relative humidity below 60% and never to exceed 90% in isolated intermittent circumstances » Minimize airborne contamination
B	» Seek indoor, secure, and well-ventilated building or equivalent enclosure (including storage trailers) » Ensure paved or well-drained floor to eliminate flooding » Ensure uniform heating and temperature control (minimum 50°F and maximum 90°F) » Maintain an environment that prevents accumulation of condensation and corrosion » Maintain minimum temperature of 40°F and maximum of 110°F » Minimize airborne contamination
C	» Seek outdoor storage area designated and marked for storage » Ensure area is well-drained (preferably graveled) and removed from actual construction area and traffic » Use appropriate coverage by means of a tarp or plastic to protect from weather elements
D	» Seek area outdoors designated and marked for storage » Ensure area is well-drained (preferably graveled) and removed from actual construction area and traffic
E	» Special storage required – refer to detailed storage instructions provided by vendor at time of purchase, and again accompanying delivery

NOTE: All materials shall always be kept from direct ground contact. All loose materials, shall, at a minimum, be placed on dunnage.

U. ENERGY EFFICIENT LAMPS

LED fixtures will be incorporated in locations required by Technical Provisions 13.5. This will apply to the VMF buildings and stations.

V. WATER EFFICIENT EQUIPMENT AND FIXTURES

Section C404 of the IECC requires gas-fired domestic water heaters with tanks less than 75,000 BTUS/HR input to have efficiency ratings of not less than 67%. Hot water piping insulation thicknesses shall be in accordance with Section C404.4, and Table C403.2.10 in the following buildings: Vehicle Maintenance Building, Transportation Building, Lechmere Station, College Avenue Station, Gilman Square traction power substation, Red Bridge traction power substation, and Ball Square traction power substation.

UTILITIES

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.9 Utilities

WBG firms past experience on MBTA and numerous other Boston area projects, have allowed our team to establish and maintain working relationships with utility owners. WBG is dedicated to partnering with local utility companies to resolve primary concerns, such as utility bridge relocations, excavations, and service interruptions with innovative design and industry-leading safety practices.

A. UTILITY INFRASTRUCTURE RELOCATION PLAN

WBG's overall approach on GLX, which also applies to the utility work scope, is to implement the existing MBTA design. This allows us to minimize design development and approvals duration and maximize the amount of field work completed in 2018. We have identified utility infrastructure requiring relocation to accommodate structure foundations, drainage systems, and other below-grade project elements. We will also confirm those utilities shown as already having been relocated.

Our utility coordination effort, working with the respective contact persons from each affected utility company, will start prior to NTP to support our Baseline Schedule dates for structure foundations. RailWorks and Comstock/Fischbach & Moore will be fully involved in utility relocation planning since this activity affects work on the current and proposed rail alignments and the overall signals and systems networks.

Identification of Existing Utility Infrastructure

WBG has analyzed existing utilities shown in the RFP documents from previous contracts, as well as concurrent works performed within the project corridor. The work scopes for the Keolis early works contracts have been reviewed to identify potential conflicts, as well as work completed subsequent to issuance of the existing utility drawings. WBG understands the importance of maintaining and protecting several key utilities such as gas mains at McGrath Highway and Medford Street, water mains at Walnut and Medford Streets, and several third party owned fiber optic and telecommunication lines that must remain operational during all construction phases. Locations at Medford, Washington, and School Streets, as well as Broadway, currently carry utilities over the proposed track via utility, pedestrian, or roadway bridges. Some utilities in these areas will be subject to relocation.

Recommended Utility Work

In addition to maintaining and protecting existing utilities, WBG has relocation plans for several areas, primarily those located on bridges requiring replacement or modifications. WBG will use potholing, test pitting, and vacuum excavation to locate lines on roadway bridges undergoing construction. DIGSAFE will be contacted to demarcate utilities within the roadway right-of-way prior to excavation at any location.

The existing Washington Street bridge utilities will be replaced on the new bridge upon its completion. Other utility relocations include School Street and Broadway. WBG intends to operate the current utility bridge as a temporary utility support until works are completed on School Street bridge. Water, MBTA power, electric, and Verizon will then be permanently placed on the roadway bridge post completion. During the construction of the Broadway bridge, Eversource and Verizon utilities will be placed on a temporary utility bridge. After completion of the bridge, the utilities will be relocated back to the existing utility bridge. Permanent relocations will be captured by the as-built utility survey.

A pre-excavation checklist will be completed prior to any activity creating a cavity below existing grade by digging, scooping, cutting, or stabbing. Utility plans must be used in conjunction with this form to determine if any utilities exist within the area of excavation or identify potential conflicts with overhead utilities. This daily checklist reminds crews to post warnings, maintain defined clearances, implement protective measures such as shoring or sloping, and review plans prior to start of excavation. Stations will have connections as necessary for storm sewer, sanitary sewer, domestic water, fire protection water, electric, telecommunication, power monitoring controls, and gas. The Lechmere Station will be designed around the existing utilities in the vicinity. The Vehicle Maintenance Building (VMB) and Transportation Building will be equipped with the same connections, but will also include any additional connections for utilities to meet the criteria set forth in Volume 2 Section 13 for rooms and areas.

Assumptions and Considerations

Locations of existing underground and overhead utilities must be field verified prior to beginning construction. Based on WBG team members' previous experience on the GLX Phase 1 contract, as well as past projects in these communities, we understand that the utility locations shown in the RFP documents may not be accurate. This experience will guide our care and vigilance in conducting excavation work within the project limits. Sitework will not be permitted to commence until:

1. DIGSAFE mark-outs have been verified.
2. A pre-excavation checklist has been completed by the crew foreman and superintendent.
3. Documents have been reviewed by our site safety professional. Any work conducted within the rail line encroachment zone will require the presence of a certified flagger.

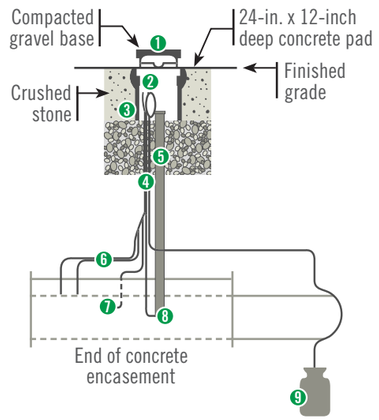
WBG's ATC 2 provides an at-grade community path crossing at Walnut Street. One major benefit of the at-grade crossing is that the existing 48-inch water main in the area will no longer require relocation.

In addition to DIGSAFE, our preconstruction utility due diligence will include coordination with the municipal and public works representatives for Cambridge, Somerville, and Medford, as well as adjacent landowners and facility management personnel. WBG will incorporate the project-specific requirements for sitework including providing support pads for exterior utility equipment including switchgear, transformers, generators, and condensers, and providing bollards within 5-foot maximum, center-to-center spacing around the exterior utility, unless otherwise required.

Design for utility relocations and tie-ins will take into account the "downstream" condition and capacity of the affected utility network, and we will address the use of compatible materials and connections. Utility work will be subject to the quality verification and documentation requirements contained in our approved Quality Management Plan. Quality control records and as-built information will be provided to the MBTA and the utility owner upon completion of work.

Figure 4.8-1 On Walsh's Yawkey Station DB project, an aging 42-inch force main running under the new station and existing commuter rail tracks required remedial repair and protection work. Repairs included corrosion inspection, patch welds, installation of a new access manway, a new cathodic protection system and concrete encasement.

1. Box with cast iron lid
2. Coiled wires to both anode wires using shunt and two split bolt connectors
3. Concrete valve box
4. Flexible conduit to protect cable insulation
5. Soil access test port with slip on cap
6. #8 AWG HMWPE wire connected to pipe
7. Coupon No. 1 with (2) #12 AWG wires embedded in concrete easement
8. Coupon No. 1 with (2) #12 AWG wires installed at bottom of test port in coupon holder
9. 48 lb, high-potential magnesium anode with (1) #12 AWG THWN wire



As noted in Volume 1 Section 3.2.3, WBG will proceed with the assumption that work completed under the prior CMGC contract meets the contractual and quality requirements of that contract. We have further assumed that the MBTA has acquired the necessary property rights for all utilities and permanent easements. As noted in Volume 1 Section 7, WBG will obtain a notice of clear right-of-way prior to entering or working in any property listed in Exhibit 2C.

On the MBTA's Blue Line State Street Station Modernization Project, Barletta used dedicated staff and subsurface utility engineering to keep the project on schedule. Twenty-four different utilities were required to be relocated or temporarily supported to provided uninterrupted services during construction.

Open cut lateral conduit crossing from the inbound to outbound platform for the Talbot Avenue Station signal and communication system. (Constructed by Barletta)

Communication and Coordination with Utility Companies

In addition to accommodating the requirements of the private companies identified in the RFP, WBG will coordinate with utility owners early and often, beginning with a kickoff meeting at which all utility owners will be asked to attend. Coordination will continue prior to and during all work activities with potential impact to utilities in the respective area. Input will be sought from utility owners to ensure the design of relocations meets their standards. Utility owners will be kept up-to-date on design status, schedule progress, permit acquisition, and potential conflicts. WBG intends to work with utility owners as key members of the project team, whose input will be crucial to maintaining the Project Schedule.

Should WBG encounter a utility that requires relocation owned by a company not listed in Volume 2 Section 7.4, we will prepare a utility agreement with that utility owner prior to relocation. Any utility relocation that must occur prior to the formal acceptance of the Baseline Schedule will be requested in writing to the MBTA, along with all known information, and adhere to the requirements of Volume 1 Section 8.7.2.3. Utility locations will be confirmed via a preconstruction survey no later than 120 days before construction activities, including test pits. WBG will submit a test pit plan to the MBTA no later than 30 days after NTP.

Managing Service Interruption

Utility service interruption will be avoided unless absolutely necessary. Outages and cutovers will be scheduled in advance and planned carefully, keeping all utility owners informed. All required shut offs will be requested to the MBTA no later than 48 hours prior to the desired shut-off and adhere to personnel requirements in Volume 1 Section 2.6.1.5. WBG will add these notifications as predecessor activities within the Baseline Schedule so they may be tracked and monitored.

Impacts to Critical Utilities

In many areas, utilities may not be in direct conflict, but will require protection from construction activities. For example, some utility lines fall very close to pier foundations. To reduce disturbance and potential damages, WBG has elected to use drilled shafts for foundations in lieu of driven piles. We are currently working on a mitigation plan for the Section 65 pipeline at Ball Square, which currently does not meet the MBTA cover criteria.

Coordination with Other Utility Infrastructure Relocations

Through regular coordination meetings and open channels of communications, all utility owners will be kept informed on design progress and upcoming works. Utility Coordinator Stephen Peters will coordinate with all private utility companies, an approach that was successfully implemented on past MBTA projects such as Commonwealth Avenue and Yawkey Station. Stephen will be responsible for arranging, hosting, and distributing the minutes of bi-weekly meetings with utility owners to discuss upcoming works and conflicts.

Supplying Utility Services

Comstock/Fischbach & Moore will assist in the coordination of permanent utility services. WBG will be responsible for power costs and consumption until turnover to the MBTA. The MBTA will be responsible for power costs associated with the overhead catenary system for train testing and commissioning.

Comstock/Fischbach, and WBG will be responsible for their temporary utilities. Potential locations requiring temporary utilities are:

- All stations
- Traction power substation
- Central instrument house
- Pump stations
- VMB
- Transportation Building

Positive Train Control Fiber Optic Cable

A major unit of the existing utility infrastructure is MBTA's Commuter Rail Positive Train Control fiber optic communication system. This operational network will require special attention to ensure it maintains functionality during relocation and all phases of construction. Any temporary outage required by our team will be formally submitted and approved by the MBTA prior to scheduling. All relocations and replacements of the fiber optic system will be in accordance with guidelines specified in Exhibit 2J of Volume 2. WBG is committed to ensuring the MBTA is equipped with all available systems necessary to ensure the safety of rail commuters.

B. BENEFITS OF OUR APPROACH TO UTILITIES

WBG team members' past project history with the MBTA and MassDOT has allowed us to establish relationships with utility owners along the project corridor. Utility companies such as NSTAR, NGrid Gas, Eversource, Level 3, Verizon, and AT&T have been active participants in the coordination and execution of previous works with members of WBG. This familiarity and experience will be crucial for immediate utility works, and also removes the learning curves associated with new working relationships.

Most recently, Walsh completed the stage 1 shutdown for the replacement of the eastbound and Green Line "B" Line spans over the Mass Turnpike. Communication and teamwork allowed one of the largest risks on the project, utility relocations and protections, to be completed in a safe and timely manner.

Walsh's Commonwealth Avenue Bridge Replacement DB project for MassDOT entails the protection and replacement of multiple utilities traversing the bridge over I-90, including support in place of two, 6-inch, oil-filled 115 Kv NStar transmission lines.

Our design has been developed to match the base contract design. Keeping a design familiar to utility owners will aid early start of construction. WBG's "top down" approach to constructing the VMB will allow for optimizing VMB utilities and process equipment while the building envelope progresses. These concurrent works aid in the overall VMB schedule.

C. UTILITY DRAWINGS

Permanent and temporary relocation/protection plans for all utility work are provided with the Composite Drawings.

COMPOSITE PLANS

THE WALSH BARLETTA GRANITE
Joint Venture Team

	SECTION 4.1 INDEX OF DRAWINGS
ITP Section	Description
A5.2.1.D.4	**Special Track Work**
	Fully Guarded 150' Radius Turnout with Flange Bearing Frog
	Modified No. 6 - Fully Guarded Crossover with LRV Jump Frogs
	Modified No. 6 - Fully Guarded Special Diamond Crossover
	Emergency Guard Rail Details
	115/132 Restraining Rail Details
	Track Fastening System Details
	Track and Signal Interface Details
	LRV Hydraulic Track Bumper Details
	Sliding Block Derail Details
A5.2.1.D.4	**Signals and Communications Infrastructure**
	Overall Signal System Schematic
	(Wayside Communications shown on Civil Corridor Plans)

	SECTION 4.2 INDEX OF DRAWINGS
ITP Section	Description
A5.2.2.A	**Elevated Guideway and Structures along the Guidway**
	Viaduct Plans and Typical Sections
	Viaduct Renderings
	Retaining Wall and Noise Barrier Plans
	Representative Wall Elevations, Sections and Details
A5.2.2.B	**Bridge and Underpass Structures**
	Washington Street
	Medford Street
	School Street
	Cedar Street
	Lowell Street
	Broadway
	College Avenue
	Medford Street
	Harvard Street
A5.2.2.C	**Geotechnical**
	(Graphic provided in narrative)

	COMPOSITE INDEX OF DRAWINGS
ITP Section	Description
A5.2.3.B	**Stations**
	Station Context Plans (Bird's Eye Renderings)
	Site Plans
	Communications Site Plans
A5.2.4	**Landscaping and Station Signage**
A5.2.4.A	Landscape Plan and Renderings
	(Graphics provided in narrative)
A5.2.4.B	Wayfinding Plans
	Wayfinding Signage Plans
	Wayfinding Renderings (Eye-level)
A5.2.5	**Vehicle Maintenance Facility**
A5.2.5.A & C	Civil
	VMF Site Context Plan
	VMF Site Plans (with Track)
	Stormwater Management Plans
	Composite Utilities Plans
A5.2.5.A	Architectural
	Maintenance Facility Renderings
	Floor and Equipment Plan
	Mezzanine Level Plan
	Elevations
	Sections
	Section
	Equipment Plan
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	Electrical Site Plans
	Electrical One Line
	Fire Alarm Riser
A5.2.5.B	Mechanical
	HVAC Plan
	HVAC Equipment Schedule
	Natural Gas
	Domestic Water and Compresssed Air
	Sanitary and Industrial Waste
A5.2.5.D	Structural
	Foundation Plan
	First Floor Slab Plan
	Sections and Details
	Civil and Guideway
A5.2.6.B	Corridor Plans and Profiles
	Typical Cross Sections
	Typical Cross Sections - Guideway Intersection Types
A5.2.6.C	Community Path Plan and Profile
A5.2.7	**Drainage Plans**
	(Graphics provided in narrative)
A5.2.9C	**Utilities**
	Representative Utility Plan

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE

THE WALSH BARLETTA GRANITE
Joint Venture Team

INDEX OF DRAWINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-G-001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
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WALSH GRANITE
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Joint Venture Team

LECHMERE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **LES-A-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

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EAST SOMERVILLE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **ESS-A-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

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GILMAN SQUARE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **GSS-A-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
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MAGOUN SQUARE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **MSS-A-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **BAS-A-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
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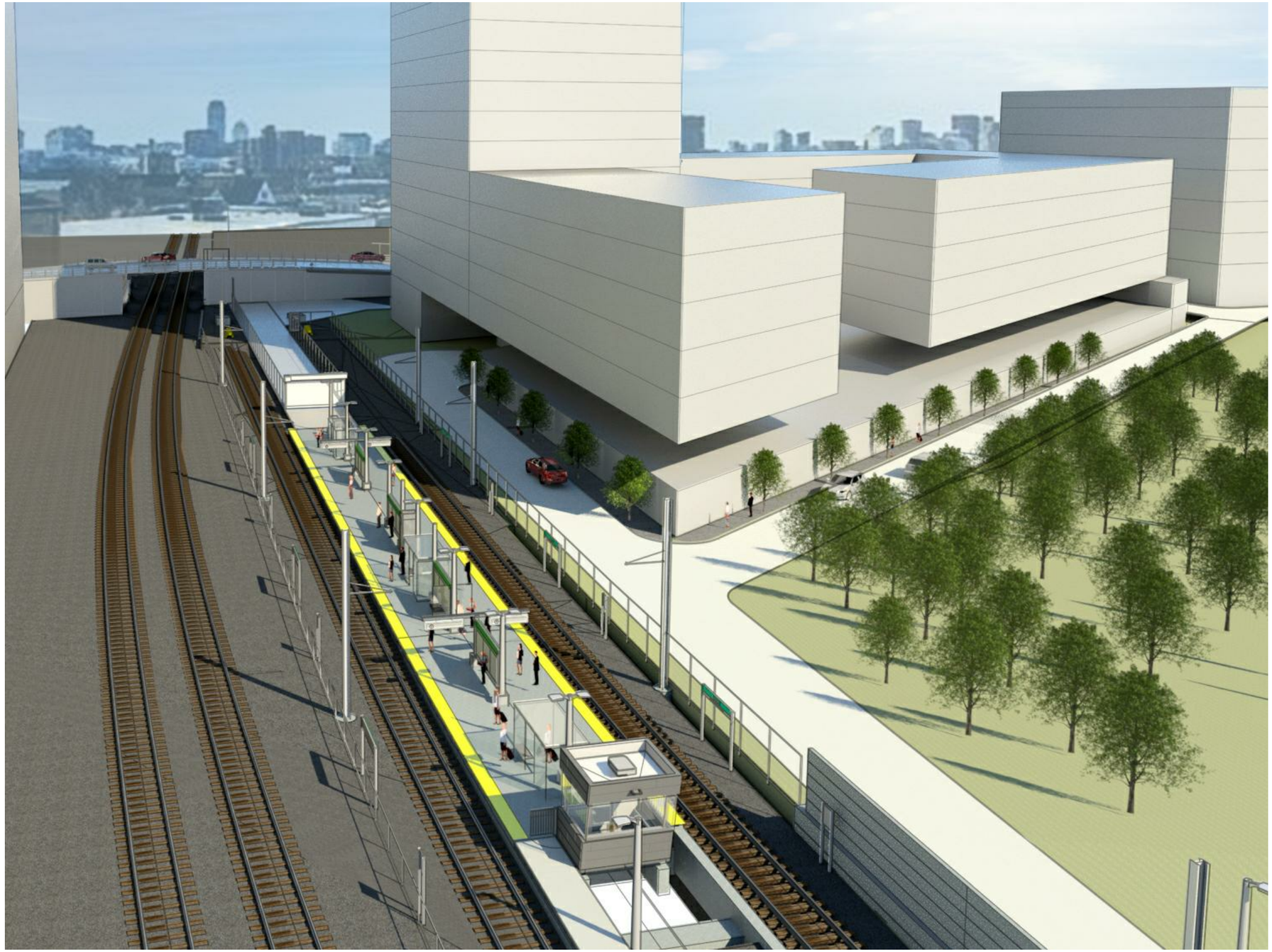
COLLEGE AVENUE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **COS-A-0001**



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

UNION SQUARE STATION
BIRD'S EYE VIEW

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **UNS-A-0001**

FUTURE DEVELOPMENT SITE

NORTH FIRST STREET (BY OTHERS)

FUTURE DEVELOPMENT SITE

LIMITS OF STATION PLATFORM ABOVE

LIMITS OF VIADUCT ABOVE

EAST ST

GLASSWORKS AVE.

MONSIGNOR O'BRIEN HIGHWAY RTE 28

CEM. CONC. WALKWAY TO BUS LOOP SEE CIVIL PLANS

NORTH HEADHOUSE

SOUTH HEADHOUSE

VIADUCT COLUMN (TYP.)

(AREA NOT SURVEYED - NOT IN SCOPE)

KEYNOTES

- 4 BICYCLE STORAGE WITH LIGHTING
- 5 FARE VENDING MACHINES
- 6 LOW CONCRETE RETAINING WALL
- 9 ACCESSIBLE PATH
- 22 ROLL UP SECURITY GRILL
- 26 ELEVATOR
- 27 METAL STAIR WITH LIGHTING
- 33 FUTURE ELEVATOR
- 34 FUTURE "RIDE" LOCATION

SHEET NOTES

1. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET

0 10 20 40 60

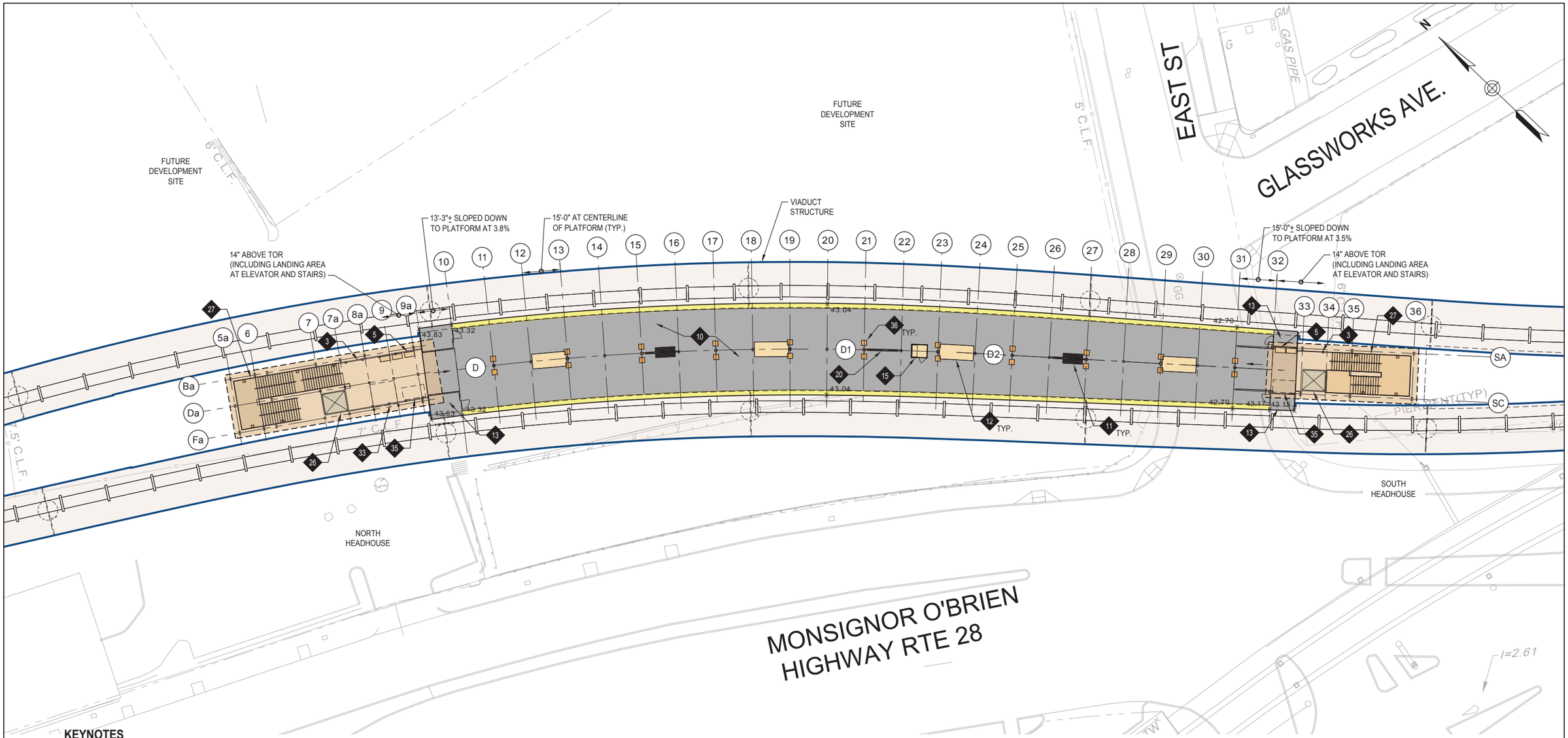
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

LECHMERE STATION
SITE PLAN
STREET LEVEL

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **LES-C-2000**


FUTURE DEVELOPMENT SITE
FUTURE DEVELOPMENT SITE
EAST ST
GLASSWORKS AVE.
GAS PIPE
GM
N
6' C.L.F.
5' C.L.F.
7' C.L.F.
5' C.L.F.
VIADUCT STRUCTURE
13'-3"± SLOPED DOWN TO PLATFORM AT 3.8%
15'-0" AT CENTERLINE OF PLATFORM (TYP.)
15'-0"± SLOPED DOWN TO PLATFORM AT 3.5%
14" ABOVE TOR (INCLUDING LANDING AREA AT ELEVATOR AND STAIRS)
14" ABOVE TOR (INCLUDING LANDING AREA AT ELEVATOR AND STAIRS)
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
27 5a 6 7 7a 8a 9 9a
33 34 35 27 36
Ba Da Fa
D D1 D2
SA SC
43.04 43.04 42.70 42.70
43.83 43.32 43.83 43.32 43.17 43.15
36 TYP.
20 15 10
12 TYP.
11 TYP.
13 5 3 26 33 35
PIER CENTER (TYP)
SOUTH HEADHOUSE
NORTH HEADHOUSE
MONSIGNOR O'BRIEN HIGHWAY RTE 28
I=2.61

KEYNOTES

- 3 MISSLE BARRIER
- 5 FARE VENDING MACHINES
- 10 PLATFORM
- 11 CUSTOMER ASSISTANCE AREA & BENCH
- 12 SHELTER
- 13 PLATFORM BOH SPACE
- 15 OFFICIALS BOOTH
- 20 SIGNAGE MAP ASSEMBLY
- 26 ELEVATORS
- 27 METAL STAIR WITH LIGHTING
- 33 FUTURE ELEVATOR
- 35 AREA OF RESCUE ASSISTANCE
- 36 LIGHT POLE (AT 30' O.C.)

SHEET NOTES

1. FOR GROUND LEVEL PLAN SEE SHEET LES-C-2000.
2. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET
0 10 20 40 60

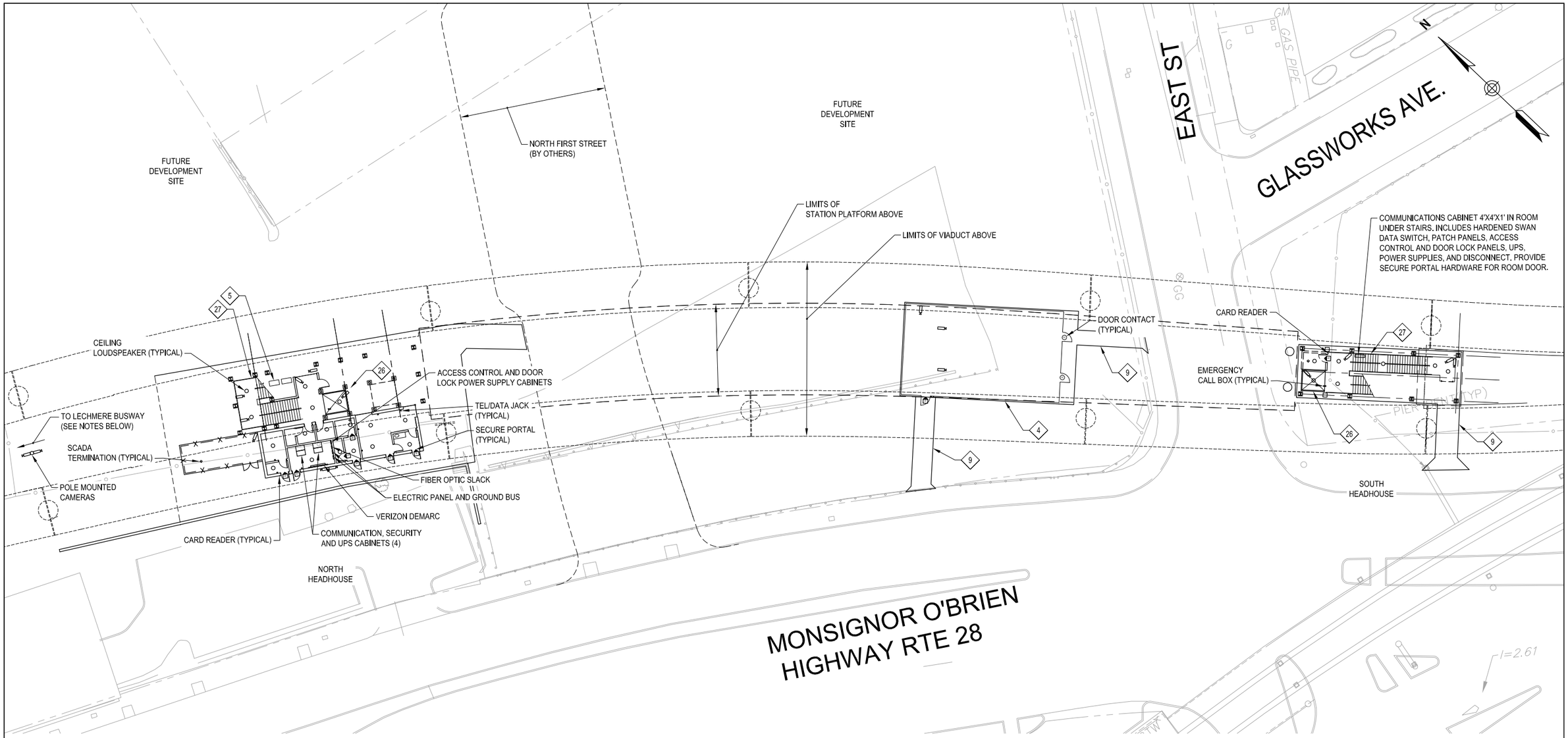
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

LECHMERE STATION
SITE PLAN
PLATFORM LEVEL

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET LES-C-2101


FUTURE DEVELOPMENT SITE
NORTH FIRST STREET (BY OTHERS)
FUTURE DEVELOPMENT SITE
EAST ST
GLASSWORKS AVE.
N
LIMITS OF STATION PLATFORM ABOVE
LIMITS OF VIADUCT ABOVE
COMMUNICATIONS CABINET 4'X4'X1' IN ROOM UNDER STAIRS. INCLUDES HARDENED SWAN DATA SWITCH, PATCH PANELS, ACCESS CONTROL AND DOOR LOCK PANELS, UPS, POWER SUPPLIES, AND DISCONNECT. PROVIDE SECURE PORTAL HARDWARE FOR ROOM DOOR.
CEILING LOUDSPEAKER (TYPICAL)
ACCESS CONTROL AND DOOR LOCK POWER SUPPLY CABINETS
TEL/DATA JACK (TYPICAL)
SECURE PORTAL (TYPICAL)
TO LECHMERE BUSWAY (SEE NOTES BELOW)
SCADA TERMINATION (TYPICAL)
POLE MOUNTED CAMERAS
FIBER OPTIC SLACK
ELECTRIC PANEL AND GROUND BUS
VERIZON DEMARC
CARD READER (TYPICAL)
COMMUNICATION, SECURITY AND UPS CABINETS (4)
DOOR CONTACT (TYPICAL)
CARD READER
EMERGENCY CALL BOX (TYPICAL)
SOUTH HEADHOUSE
NORTH HEADHOUSE
MONSIGNOR O'BRIEN HIGHWAY RTE 28
I=2.61

KEYNOTES

- 4 BICYCLE STORAGE
- 5 FARE VENDING MACHINES
- 9 ACCESSIBLE PATH
- 26 ELEVATOR
- 27 METAL STAIR

LECHMERE BUSWAY - COMMUNICATIONS AND SECURITY WORK TO INCLUDE:

1. INSTALLING FIBER OPTIC CABLE FROM THE STATION COMMUNICATION ROOM TO THE COMMUNICATIONS CLOSET IN THE BUS OPS KISOK TO FACILITATE EXTENDING THE WAN AND SWAN LOCAL AREA NETWORKS TO THE BUS LOOP.
2. INSTALLING WAN AND SWAN DATA SWITCHES IN THE COMMUNICATIONS CLOSET IN THE BUS OPS KIOSK TO SERVICE THE BUS LOOPS COMMUNICATIONS AND SECURITY DEVICES.
3. INSTALLING TWO POLE MOUNTED CCTV CAMERAS AT FOUR LOCATIONS AROUND THE PERIMETER OF THE BUS LOOP.
4. INSTALLING PUBLIC ADDRESS HORN TYPE LOUDSPEAKERS AROUND THE PERIMETER OF THE BUS LOOP.
5. INSTALLING TRANSIT PASSENGER INFORMATION SYSTEM VARIABLE MESSAGE SIGNS AT EACH BERTH.
6. INSTALLING ONE AMBIENT NOISE MICROPHONE AT BERTHS 1 AND 2, AND ONE AT BERTHS 3 AND 4.
7. INSTALLING ONE EMERGENCY CALL BOX AT BERTHS 1 AND 2, AND ONE AT BERTHS 3 AND 4.
8. INSTALLING TELECOMMUNICATIONS SERVICES AND PUBLIC ADDRESS MICROPHONE IN THE BUS OPS KIOSK.
9. INSTALLING DATA CONNECTIONS FOR AFC2.0 EQUIPMENT IN THE BUS LOOP.

SCALE IN FEET
0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

LECHMERE STATION COMMUNICATION AND SECURITY PLAN STREET LEVEL

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **LES-SC-2000**

FUTURE DEVELOPMENT SITE

FUTURE DEVELOPMENT SITE

EAST ST

GLASSWORKS AVE.

N

VIADUCT STRUCTURE

CEILING LOUDSPEAKER

SPTO MONITOR

STANCHION MOUNTED EMERGENCY CALL BOX

CCTV CAMERA

STANCHION MOUNTED EMERGENCY CALL BOX

TEL/DATA JACK

CEILING LOUDSPEAKER

11 TYP.

12 TYP.

SIGN POLE FOR VMS (2) AND AMBIENT NOISE MICROPHONE

COMMUNICATIONS CLOSET IN BOOTH WITH HARDENED SWAN WAN SWITCHES, PATCH PANELS, UPS, AND POWER SUPPLY.

SPTO MONITOR

SIGN POLE FOR VMS (2) AND AMBIENT NOISE MICROPHONE

SOUTH HEADHOUSE

NORTH HEADHOUSE

MONSIGNOR O'BRIEN HIGHWAY RTE 28

KEYNOTES

- 5 FARE VENDING MACHINES
- 10 PLATFORM
- 11 CUSTOMER ASSISTANCE AREA & BENCH
- 12 SHELTER
- 13 PLATFORM BOH SPACE
- 15 OFFICIALS BOOTH
- 26 ELEVATORS
- 27 FUTURE ELEVATOR
- 35 AREA OF RESCUE ASSISTANCE

SHEET NOTES

1. FOR STREET LEVEL PLANS SEE SHEET LES-SC-2000.

SCALE IN FEET

0 10 20 40 60

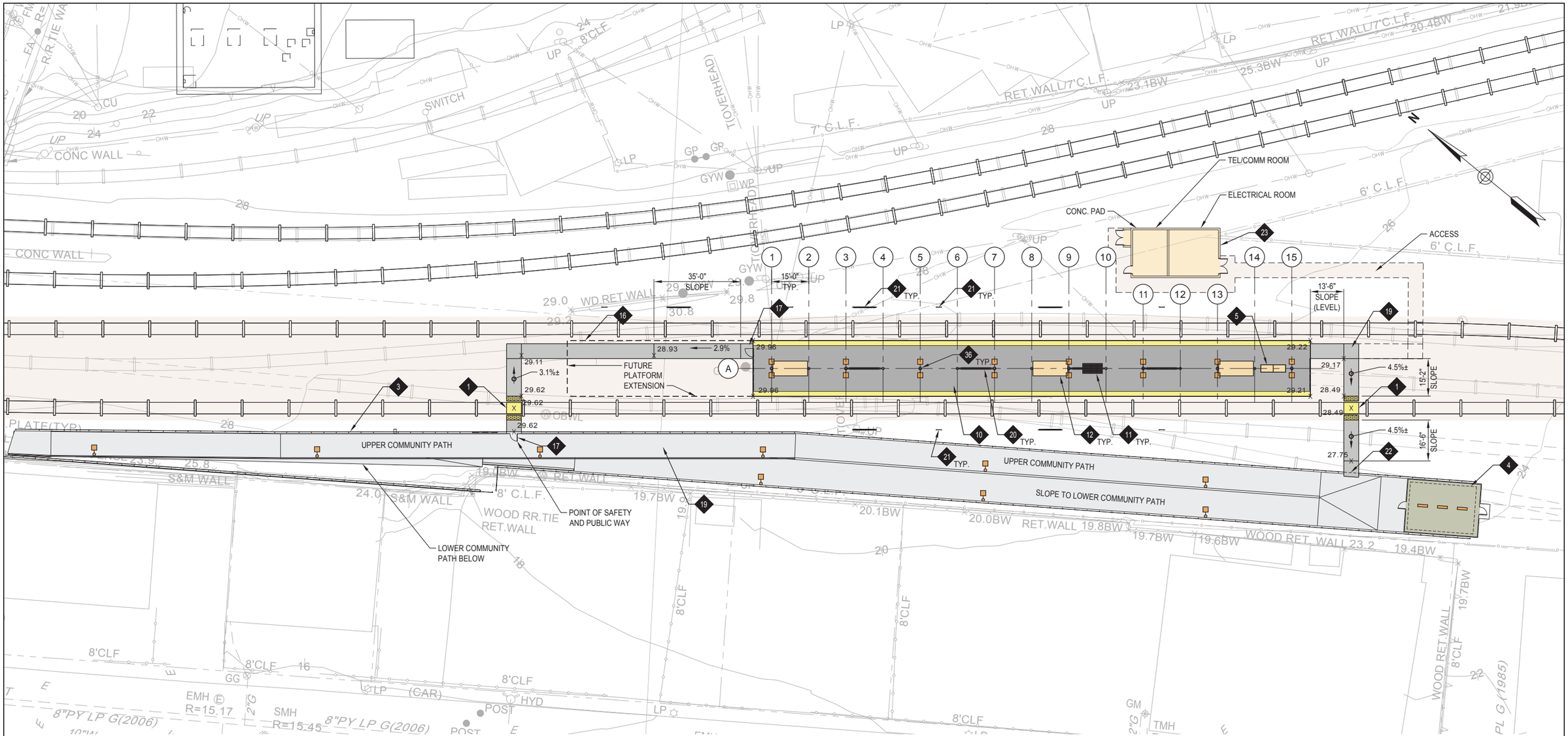
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

LECHMERE STATION COMMUNICATION AND SECURITY PLAN PLATFORM LEVEL

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET LES-SC-2101



KEYNOTES

1. TRACK CROSSING
3. MISSILE BARRIER
4. BICYCLE STORAGE WITH LIGHTING
5. FARE VENDING MACHINES
6. CONCRETE RETAINING WALLS
10. PLATFORM
11. CUSTOMER ASSISTANCE AREA & BENCH
12. SHELTER
16. EMERGENCY EGRESS WALKWAY AT GRADE
17. EMERGENCY EGRESS GATE
19. SLOPED WALKWAY
20. SIGNAGE MAP ASSEMBLY
21. SIGNAGE
22. ROLL UP SECURITY GRILL
23. CMU BUILDING
36. LIGHT POLE (AT 30' O.C.)

SHEET NOTES

1. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET
0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

EAST SOMERVILLE STATION SITE PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET WAS-C-2001

WASHINGTON STREET PUMP STATION CONTROL ROOM

WASHINGTON STREET PUMP STATION

FIBER OPTIC SLACK
TEL./COMM.
COMMUNICATION CABINETS
ELECTRIC PANEL
SECURITY CABINET
FIRE SUPPRESSION ROOM
UPS CABINET
GROUND BAR
ELEC.
CARD READER
WALL PHONE
CARD READER
CARD READER
VERIZON DEMARC
ACCESS CONTROL AND DOOR LOCK POWER SUPPLY CABINETS

SPTO MONITOR
STANCHION MOUNTED EMERGENCY CALL BOX
STANCHION MOUNTED EMERGENCY CALL BOX
POLE MOUNTED CAMERAS
FUTURE PLATFORM EXTENSION
POLE MOUNTED CAMERAS
COMMUNICATIONS CABINET (4'X4'X1')
SPTO MONITOR
TYP.
TYP.
SIGN POLE FOR VMS (2), AMBIENT NOISE MICROPHONE, PA MICROPHONE, AND ENCLOSURE
CARD READER
EMERGENCY CALL BOX
UPPER COMMUNITY PATH
UPPER COMMUNITY PATH
SLOPE TO LOWER COMMUNITY PATH
POLE MOUNTED CAMERAS
POINT OF SAFETY AND PUBLIC WAY
POLE MOUNTED CAMERAS
LOWER COMMUNITY PATH BELOW
SIGN POLE FOR VMS (2) AND AMBIENT NOISE MICROPHONE
POLE MOUNTED CAMERAS

KEYNOTES

4 BICYCLE STORAGE

5 FARE VENDING MACHINES

11 CUSTOMER ASSISTANCE AREA & BENCH

12 SHELTER

SCALE IN FEET
0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

EAST SOMERVILLE STATION COMMUNICATIONS AND SECURITY PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **WAS-SC-2001**

MEDFORD ST

TPPS

ENCLOSED TRANSFORMER YARD

MATCH LINE - SEE BELOW FOR CONTINUATION

FUTURE PLATFORM EXTENSION

15'-0" TYP.

21 TYP.

12'-0" SLOPE

19

17

10

36 TYP.

12 TYP.

11 TYP.

20 TYP.

35

27

CONCRETE PAD AT GRADE (BELOW ELEVATED WALKWAY) FOR TRANSFORMER

ELEVATED WALKWAY WITH MISSLE BARRIER

22

EXISTING UTILITY BRIDGE

CONC. BRIDGE ABUTMENT

STATION ENTRY AREA AND ELEVATED LANDING WITH MISSLE BARRIER

PROP. BRIDGE STRUCTURE COORDINATE ACCESS TO STATION THROUGH PARAPET RAIL

BRIDGE GIRDER (TYP.)

PRECAST CONC.RET.WALL

ECR

COMM.

ELEC.

1.50% (193')

4.2%

14" ABOVE TOR

8" ABOVE TOR

26

5

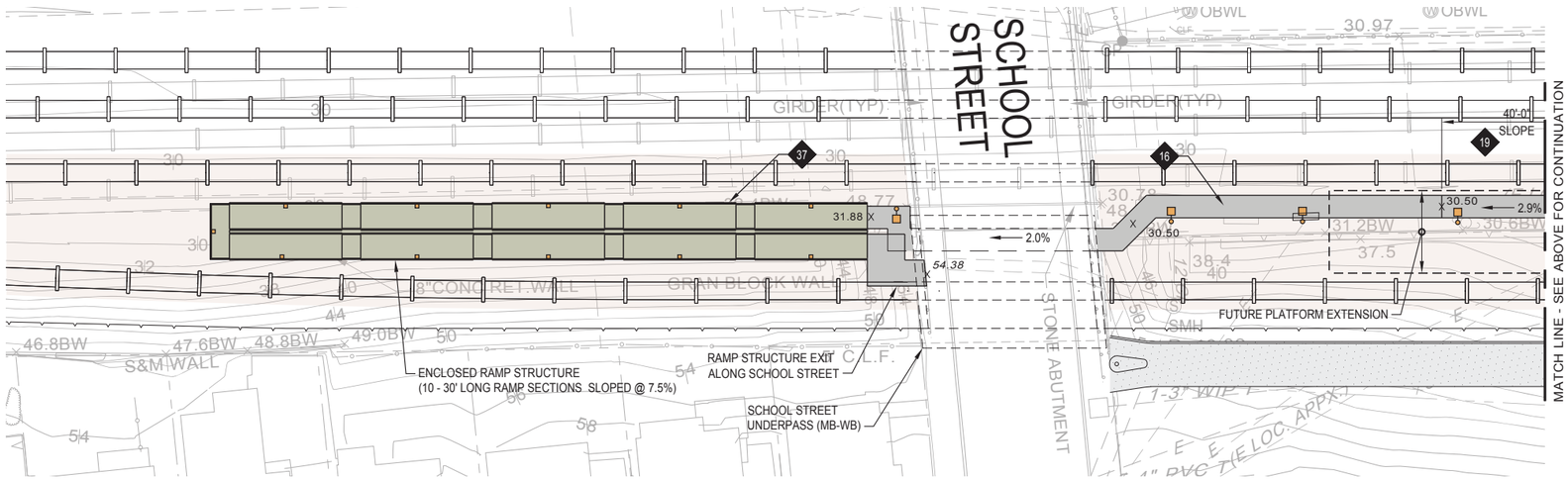
ELEVATOR CONTROL ROOM, COMM. AND ELEC. ROOMS (BELOW ELEVATED WALKWAY)

4

PLACE SLAB OVER EXISTING UTILITY BRIDGE (SEE STRUCTURAL PLANS)

COMMUNITY PATH

2'CONC CAP ON STONE RET. WALL



KEYNOTES

4	BICYCLE STORAGE WITH LIGHTING	20	SIGNAGE MAP ASSEMBLY
5	FARE VENDING MACHINES	21	SIGNAGE
10	PLATFORM	22	ROLL UP SECURITY GRILL
11	CUSTOMER ASSISTANCE AREA & BENCH	26	ELEVATOR
12	SHELTER	27	METAL STAIR WITH LIGHTING
16	EMERGENCY EGRESS WALKWAY AT GRADE	35	AREA OF RESCUE ASSISTANCE
17	EMERGENCY EGRESS GATE	36	LIGHT POLE (AT 30' O.C.)
19	SLOPED WALKWAY	37	EMERGENCY EGRESS RAMP WITH LIGHTING

SHEET NOTES

1. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET
0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

GILMAN SQUARE STATION SITE PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET GSS-C-2001

MATCH LINE – SEE BELOW FOR CONTINUATION

MEDFORD ST

TPPS

ENCLOSED TRANSFORMER YARD

BUNTER

CONC. BRIDGE ABUTMENT

BRIDGE GIRDER (TYP.)

STATION ENTRY AREA AND ELEVATED LANDING WITH MISSILE BARRIER

WAYSIDE TELEPHONE

SPTO MONITOR

STANCHION MOUNTED EMERGENCY CALL BOX

12 TYP.

11 TYP.

STANCHION MOUNTED EMERGENCY CALL BOX

EMERGENCY CALL BOX (TYPICAL)

SCADA TERMINATION

WALL PHONE (TYPICAL)

ACCESS CONTROL AND DOOR LOCK POWER SUPPLY CABINETS

FIBER OPTIC SLACK

ELECTRIC PANEL AND GROUND BUS

POLE MOUNTED CAMERAS

ELEVATED WALKWAY WITH MISSLE BARRIER

POLE MOUNTED CAMERAS

CARD READER

BIT. DRIVE

DOOR CONTACT FOR GATE

COMMUNICATIONS CABINET 4'X4'X1'

SIGN POLE FOR VMS (2) AND AMBIENT NOISE MICROPHONE

PA MICROPHONE AND ENCLOSURE

5

SPTO MONITOR

CEILING LOUDSPEAKER

VERIZON DEMARC

CONCRETE PADS AT GRADE (BELOW ELEVATED WALKWAY) FOR TRANSFORMER

ELEVATOR CONTROL ROOM, COMM. AND ELEC. ROOMS (BELOW ELEVATED WALKWAY)

COMMUNICATION, SECURITY AND UPS CABINETS (4)

COMMUNITY PATH

4

EMERGENCY CALL BOX

POLE MOUNTED CAMERAS

SCHOOL STREET

CAMERAS AND EMERGENCY CALL BOX

37

POLE MOUNTED CAMERAS AND EMERGENCY CALL BOX

GRASS

CONC. PAD

SIG.CASE

COMMUNICATIONS CABINET 4'X4'X1'

ENCLOSED RAMP STRUCTURE

RAMP STRUCTURE EXIT ALONG SCHOOL STREET

SCHOOL STREET UNDERPASS (MB-WB)

ABUTMENT

MATCH LINE – SEE ABOVE FOR CONTINUATION

KEYNOTES

4 BICYCLE STORAGE WITH LIGHTING

5 FARE VENDING MACHINES

11 CUSTOMER ASSISTANCE AREA & BENCH

12 SHELTER

SCALE IN FEET

0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

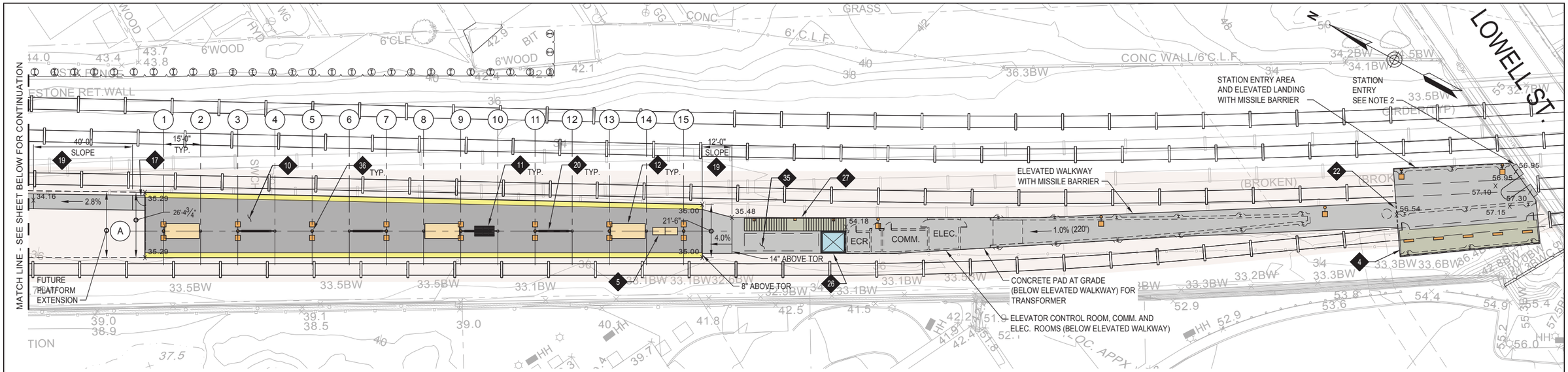
DESIGN BUILD - MBTA CONTRACT NO. E22CN07

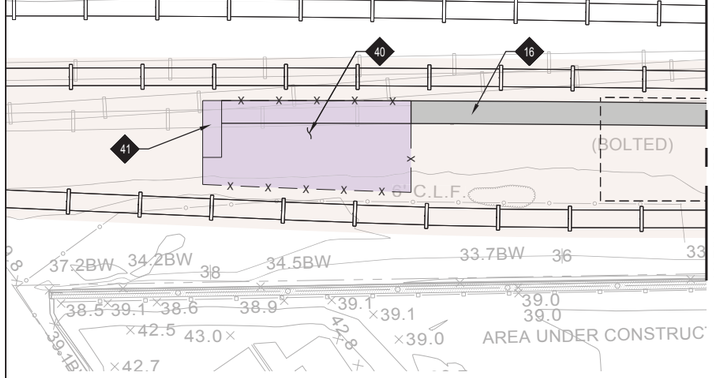
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

GILMAN SQUARE STATION COMMUNICATIONS AND SECURITY PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET GSS-SC-2001





KEYNOTES

- 4 BICYCLE STORAGE WITH LIGHTING
- 5 FARE VENDING MACHINES
- 10 PLATFORM
- 11 CUSTOMER ASSISTANCE AREA & BENCH
- 12 SHELTER
- 16 EMERGENCY EGRESS WALKWAY AT GRADE
- 17 EMERGENCY EGRESS GATE
- 19 SLOPED WALKWAY
- 20 SIGNAGE MAP ASSEMBLY
- 22 ROLL UP SECURITY GRILL
- 26 ELEVATOR
- 27 METAL STAIR
- 35 AREA OF RESCUE ASSISTANCE
- 36 LIGHT POLE (AT 30' O.C.)
- 40 SAFE DISPERSAL AREA (APPROX. 1,300 S.F.)
- 41 ACCESSIBLE SPACES

SHEET NOTES

1. PLATFORM WIDTH VARIES: 21'-6" AT SOUTH END AND 26'-5"± AT NORTH END.
2. STATION ENTRY:
   - CUT TWO - 5 FOOT ENTRIES INTO EXISTING BRIDGE PARAPET WALL
   - REMOVE EXISTING MISSILE BARRIER FROM TOP OF PARAPET WALL
   - REPAIR MISSILE BARRIER AS REQUIRED
3. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN

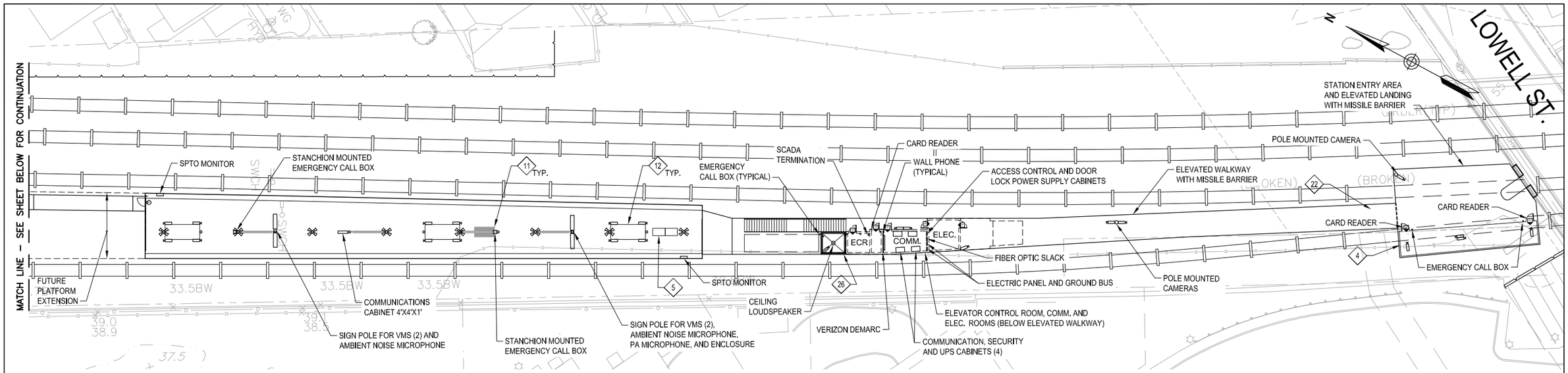
SCALE IN FEET
0 10 20 40 60

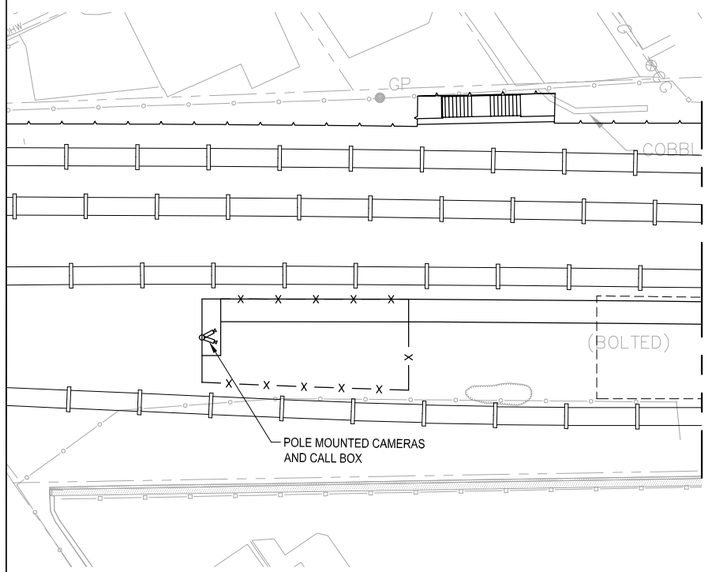
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MAGOUN SQUARE STATION SITE PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET MSS-C-2001





KEYNOTES

- 4 BIKE SHELTER
- 5 FARE VENDING MACHINES
- 11 CUSTOMER ASSISTANCE AREA & BENCH
- 12 SHELTER
- 26 ELEVATOR

SCALE IN FEET
0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MAGOUN SQUARE STATION
COMMUNICATIONS AND SECURITY PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **MSS-SC-2001**

MATCH LINE - SEE SHEET BAS-C-2002 FOR CONTINUATION

BROADWAY

BOSTON AVE.

FUTURE PLATFORM EXTENSION

30' WIDE GATE FOR HI RAIL VEHICLE ACCESS

TRACTION POWER SUBSTATION

640 BOSTON AVE. (DEVELOPMENT UNDER CONSTRUCTION)

FUTURE T.O.D. PARCEL (APPROX. 12,500 S.F.)

COMM. ROOM AND ELEC. ROOM SLAB AT GRADE

STATION ENTRANCE

BROADWAY BRIDGE

FOUNDATION REMAINS

24"CI MWRA WATER

2-30" 345KV PTC E

KEYNOTES

1. TRACK CROSSING
3. 8' HIGH SECURITY FENCE
4. BICYCLE STORAGE WITH LIGHTING
5. FARE VENDING MACHINES
10. PLATFORM
11. CUSTOMER ASSISTANCE AREA & BENCH
12. SHELTER
16. EMERGENCY EGRESS WALKWAY AT GRADE
17. EMERGENCY EGRESS GATE
19. SLOPED WALKWAY AT GRADE
20. SIGNAGE MAP ASSEMBLY
21. SIGNAGE
22. ROLL UP SECURITY GRILL
23. CMU BUILDING
36. LIGHT POLE (AT 30' O.C.)
37. EMERGENCY EGRESS RAMP

SHEET NOTES

1. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET

0 10 20 40 60

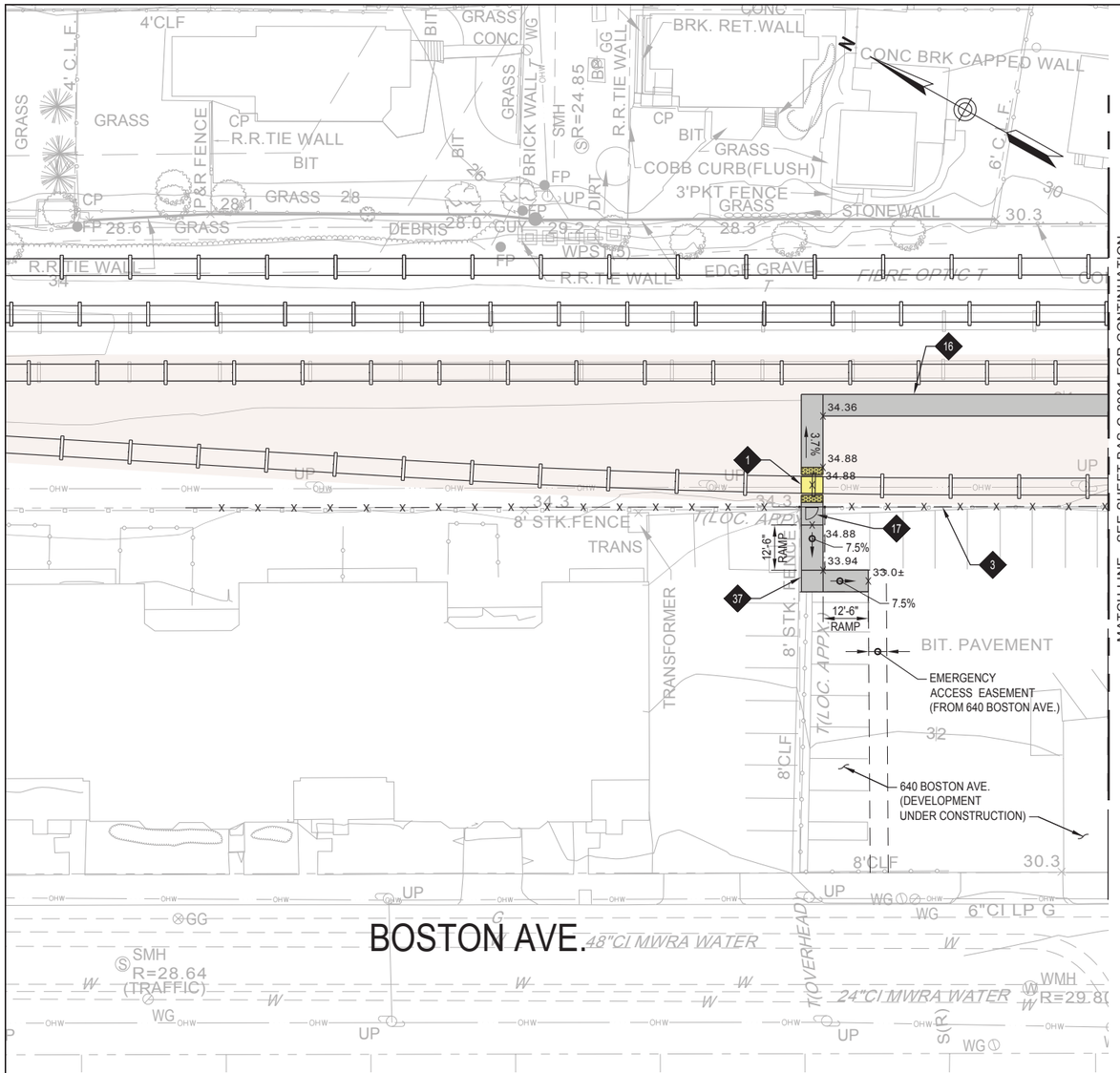
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION
SITE PLAN
SHEET 1

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **BAS-C-2001**



SHEET NOTES

1. SEE SHEET 1 FOR KEYNOTES.

SCALE IN FEET

0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION
SITE PLAN
SHEET 2

DATE: SEPT. 28, 2017	SCALE: 1" = 40'	SHEET **BAS-C-2002**

MATCH LINE – SEE BELOW FOR CONTINUATION

SPTO MONITOR

STANCHION MOUNTED EMERGENCY CALL BOX

STANCHION MOUNTED EMERGENCY CALL BOX

POLE MOUNTED VMS SIGNS, ANM., PA MICROPHONE, AND ENCLOSURE

POLE MOUNTED CAMERAS AND CALL BOX

FUTURE PLATFORM EXTENSION

COMMUNICATIONS CABINET 4'X4'X1'

TRACTION POWER SUBSTATION

POLE MOUNTED CAMERAS AND CALL BOX

SPTO MONITOR

COMMUNICATION, SECURITY AND UPS CABINETS

ELEC.

COMM.

CARD READER

WALL PHONE

VERIZON DEMARC

FIBER OPTIC SLACK

GROUND BAR

ELECTRIC PANEL

ACCESS CONTROL AND DOOR LOCK POWER SUPPLY CABINETS

COMM. ROOM AND ELEC. ROOM ON SLAB AT GRADE

BROADWAY

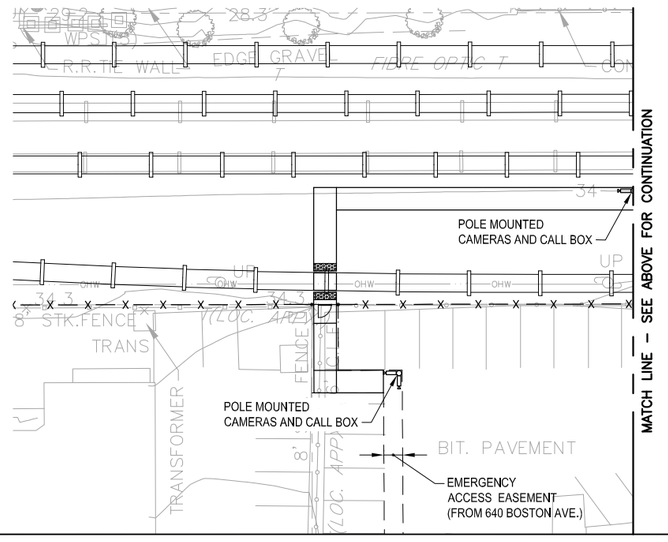
EXISTING RIGHT OF WAY

(CAR)

(TRAFFIC)

BOSTON AVE.

STATION ENTRANCE



KEYNOTES

5 FARE VENDING MACHINES

10 PLATFORM

11 CUSTOMER ASSISTANCE AREA & BENCH

12 SHELTER

SCALE IN FEET

0 10 20 40 60

4-120

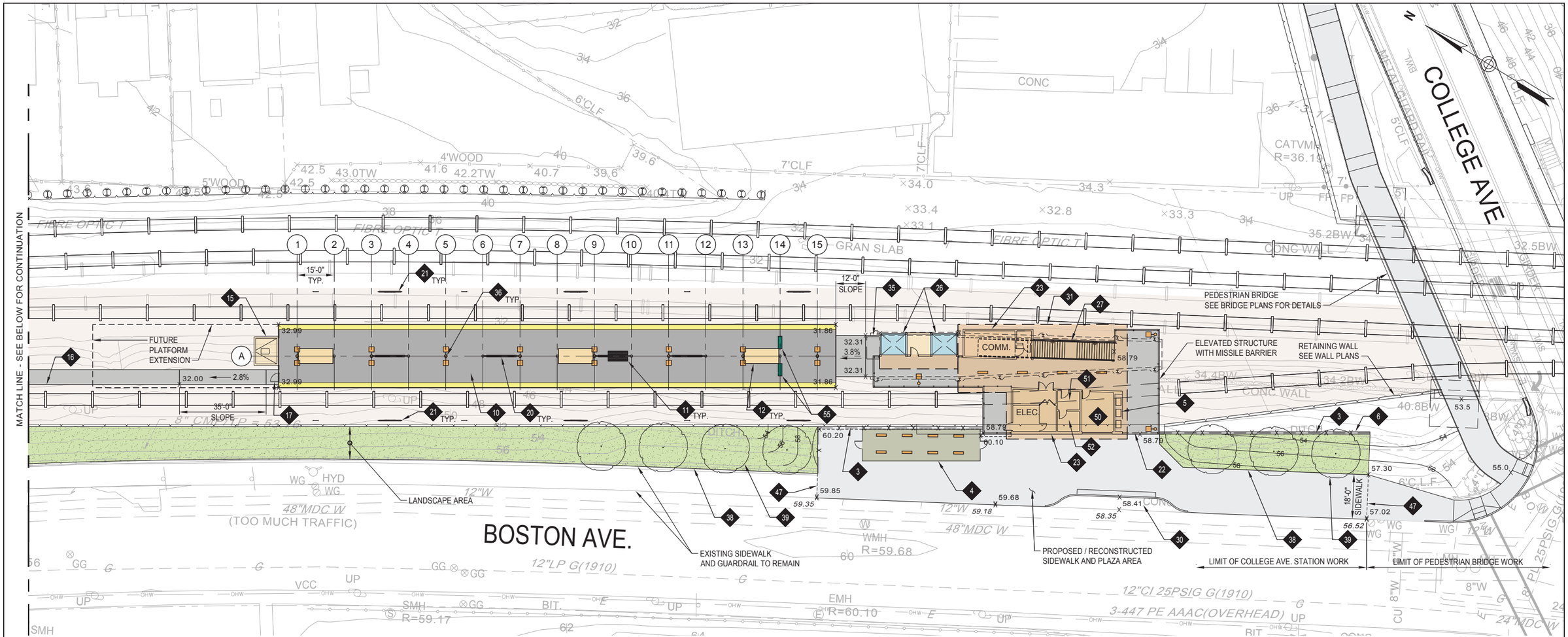
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

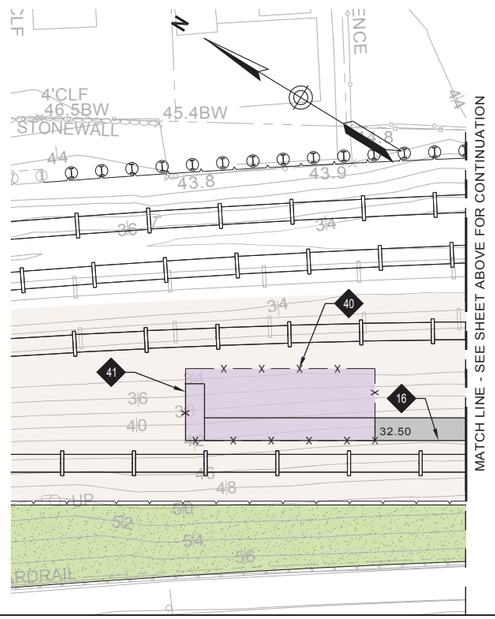
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION COMMUNICATIONS AND SECURITY PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **BAS-SC-2001**





KEYNOTES

- 3 — 8' HIGH SECURITY FENCE
- 4 — BICYCLE STORAGE WITH LIGHTING
- 5 — FARE VENDING MACHINES
- 6 — CONCRETE RETAINING WALLS
- 10 — PLATFORM
- 11 — CUSTOMER ASSISTANCE AREA & BENCH
- 12 — SHELTER
- 15 — STARTER'S BOOTH
- 16 — EMERGENCY EGRESS WALKWAY AT GRADE
- 17 — EMERGENCY EGRESS GATE
- 20 — SIGNAGE MAP ASSEMBLY
- 21 — SIGNAGE
- 22 — ROLL UP SECURITY GRILL
- 23 — CMU BUILDING
- 26 — ELEVATORS AND CONTROL ROOM
- 27 — METAL STAIR
- 30 — "RIDE' LOCATION (2 SPOTS)
- 31 — BUILT UP ROOFING
- 35 — AREA OF RESCUE ASSISTANCE
- 36 — LIGHT POLE (AT 30' O.C.)
- 38 — LANDSCAPE AREA
- 39 — TREES (AT 25' 0.C.)
- 40 — SAFE DISPERSAL AREA
- 41 — ACCESSIBLE SPACES
- 47 — LIMIT OF SIDEWALK WORK
- 50 — OPERATORS LOUNGE
- 51 — TOILET ROOM
- 52 — JANITOR CLOSET
- 55 — "NEXT TRAIN" SIGN

SHEET NOTES

1. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET
0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

COLLEGE AVENUE STATION SITE PLAN

DATE: SEPT. 28, 2017 | SCALE: 1"=40' | SHEET COS-C-2001

MATCH LINE – SEE BELOW FOR CONTINUATION

COLLEGE AVE

BOSTON AVE.

TEL/DATA JACK

STANCHION MOUNTED EMERGENCY CALL BOX

STANCHION MOUNTED EMERGENCY CALL BOX

POLE MOUNTED VMS SIGNS AND ANM.

FIBER OPTIC SLACK

GROUND BAR

ELECTRIC PANEL

CARD READER

COMMUNICATION, SECURITY AND UPS CABINETS

VERIZON DEMARC

WALL PHONE

CCTV CAMERA

CEILING LOUDSPEAKER

FUTURE PLATFORM EXTENSION

SPTO MONITOR

COMM. ROOM

ELEC. ROOM

ACCESS CONTROL AND DOOR LOCK POWER SUPPLY CABINETS

POLE MOUNTED CAMERAS

COMMUNICATIONS CABINET 4'X4'X1'

TYP.

TYP.

DITCH

DITCH

6' C.L.F.

53.5

55.0

MATCH LINE – SEE SHEET ABOVE FOR CONTINUATION

POLE MOUNTED CAMERAS AND CALL BOX

KEYNOTES

4 BICYCLE STORAGE

5 FARE VENDING MACHINES

10 PLATFORM

11 CUSTOMER ASSISTANCE AREA & BENCH

12 SHELTER

16 EMERGENCY EGRESS WALKWAY AT GRADE

26 ELEVATORS AND CONTROL ROOM

27 METAL STAIR

50 OPERATORS LOUNGE

51 TOILET ROOM

52 JANITOR CLOSET

SCALE IN FEET

0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE

THE WALSH BARLETTA GRANITE

Joint Venture Team

COLLEGE AVENUE STATION COMMUNICATIONS AND SECURITY PLAN

DATE: SEPT. 28, 2017 | SCALE: 1"=40' | SHEET **COS-SC-2001**

UNION SQUARE

BENNETT COURT

PROSPECT STREET

25' WIDE WALKWAY TO BENNETT COURT

CHARLESTOWN ST.

PROPOSED DEVELOPMENT

BATHROOM AND JANITOR CLOSET BY OTHERS

LOUNGE BY OTHERS

MBTA RIDE DROP OFF

CEMENT CONCRETE ENTRANCE WALKWAY

ELEC.

COMM.

C.I.P. CONC. WALL

STEEL SLEEVE

END OF PERIMETER FENCE

25'-0" SLOPE

15'-0" TYP.

14" ABOVE TOR

8" ABOVE TOR

1.6%

22'-6" PLATFORM

9.99

9.97

10.39

TYP.

FUTURE PLATFORM EXTENSION

10.76

2.9%

35'-0" SLOPE

POINT OF SAFETY AND PUBLIC WAY

ACCESSIBLE EGRESS GATE AT SOUND WALL

8.2±

8.5±

9.9±

9.7±

BROKEN BIT. PAVEMENT

BIT. PAVEMENT

(UNDER STOCKPILE)

1 STY CONC. BLOCK

SHED

6'WF

10'WF

6'WOOD FENCE

4'IRON FENCE

CONC. CURB

BIT BERM

CLF/10'MTF

8'MTF

GUY POLE

KEYNOTES

1. TRACK CROSSING
2. CHAINLINK FENCE
4. BICYCLE STORAGE (BY OTHERS)
5. FARE VENDING MACHINES
6. CONCRETE RETAINING WALLS
10. PLATFORM
11. CUSTOMER ASSISTANCE AREA & BENCH
12. SHELTER
15. STARTERS BOOTH
16. EMERGENCY EGRESS WALKWAY AT GRADE
17. EMERGENCY EGRESS GATE
19. SLOPED WALKWAY
20. SIGNAGE MAP ASSEMBLY
21. SIGNAGE
22. ROLL UP SECURITY GRILL
23. CMU BUILDING
36. LIGHT POLE (AT 30' O.C.)
55. "NEXT TRAIN" SIGN

SHEET NOTES

1. FOR SITE LAYOUT OF COMMUNICATION EQUIPMENT AND VMS SIGNAGE, SEE COMMUNICATION AND SECURITY PLAN.

SCALE IN FEET

0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE Joint Venture Team

UNION SQUARE STATION SITE PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET UNS-C-2001

UNION SQUARE

STREET CONNECTION WALKWAY

PROPOSED DEVELOPMENT

POLE MOUNTED CAMERAS

SECURE PORTAL (LOCATION TBD)

CARD READER

EMERGENCY CALL BOX

4

BATHROOM BY OTHERS

LOUNGE BY OTHERS

MBTA RIDE DROP OFF

CARD READER

FIBER OPTIC SLACK

ELECTRIC PANEL

GROUND BAR

WALL PHONE

VERIZON DEMARC

CARD READER

SECURE PORTAL

FIRE SUPPRESSION ROOM

COMMUNICATION CABINETS

SECURITY CABINET

UPS CABINET

ACCESS CONTROL AND DOOR LOCK POWER SUPPLY CABINETS

10' MESH FENCE

POLE MOUNTED CAMERAS

POLE MOUNTED HORN LOUDSPEAKERS

STANCHION MOUNTED EMERGENCY CALL BOX

COMMUNICATIONS CABINET 4'X4'X1'

10

12 TYP.

11 TYP.

SPTO MONITOR

15

DUAL DATA OUTLET

FUTURE PLATFORM EXTENSION

5

SPTO MONITOR

CEILING LOUDSPEAKER WITH VOLUME CONTROL

POLE MOUNTED CAMERAS

SIGN POLE FOR VMS (2), AMBIENT NOISE MICROPHONE, PA MICROPHONE, AND ENCLOSURE

STANCHION MOUNTED EMERGENCY CALL BOX

SIGN POLE FOR VMS (2) AND AMBIENT NOISE MICROPHONE

CARD READER

CAMERA

ELEC. & COMM. ROOMS

PROSPECT STREET

(UNDER STOCKPILE)

N

KEYNOTES

4 BICYCLE STORAGE (BY OTHERS)

5 FARE VENDING MACHINES

10 PLATFORM

11 CUSTOMER ASSISTANCE AREA & BENCH

12 SHELTER

15 STARTERS BOOTH

SCALE IN FEET

0 10 20 40 60

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

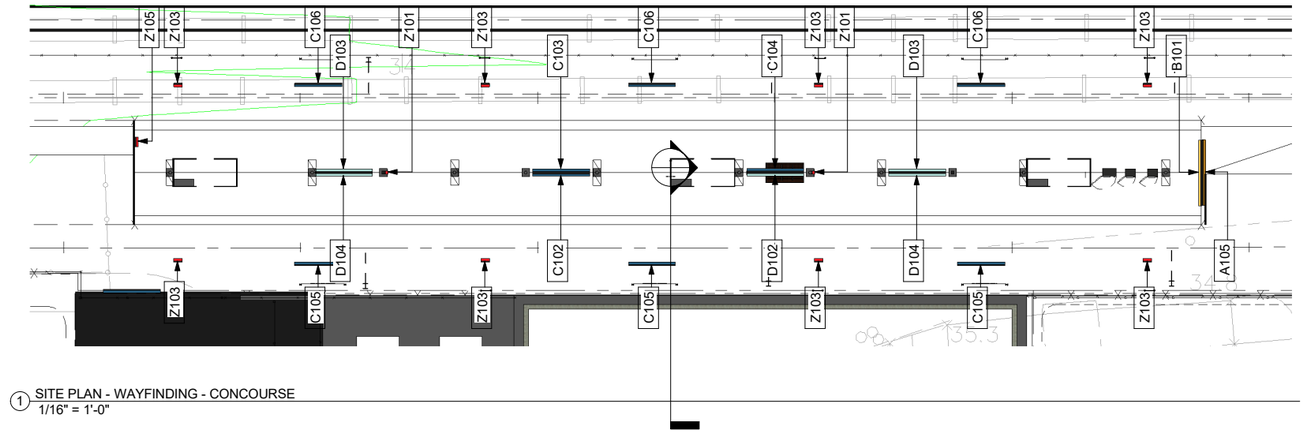
WALSH GRANITE

THE WALSH BARLETTA GRANITE

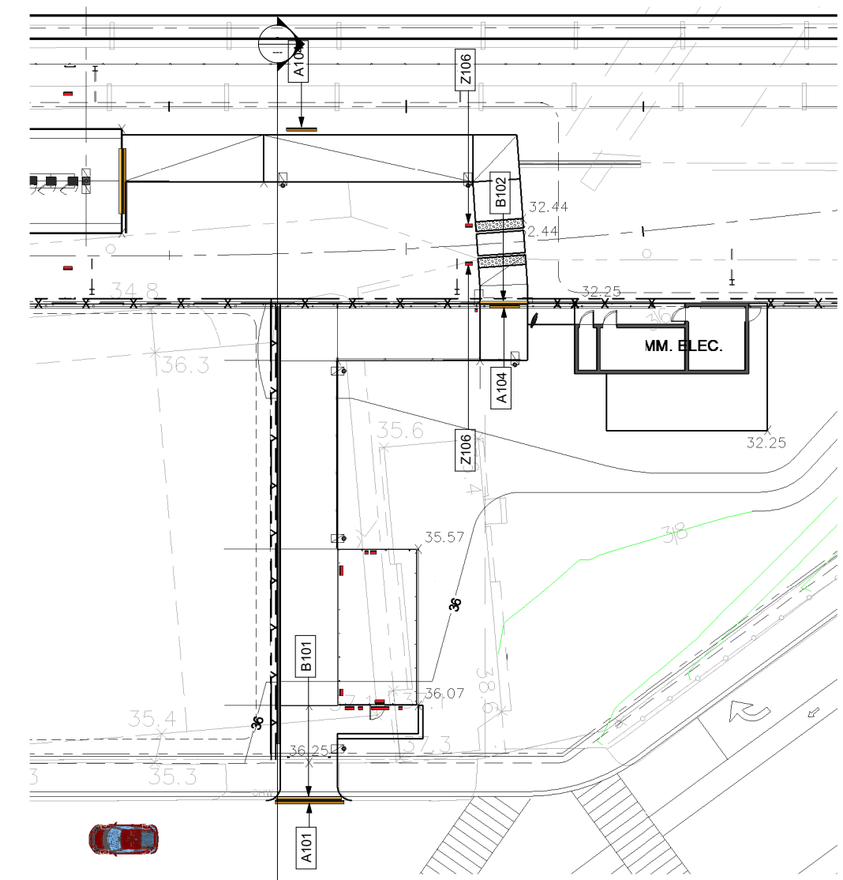
Joint Venture Team

UNION SQUARE STATION COMMUNICATIONS AND SECURITY PLAN

DATE: SEPT. 28, 2017 | SCALE: 1" = 40' | SHEET **UNS-SC-2001**



1 SITE PLAN - WAYFINDING - CONCOURSE
1/16" = 1'-0"



3 SITE PLAN - WAYFINDING - ENTRY
1/16" = 1'-0"

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION
WAYFINDING PLANS LEVEL ONE

DATE: SEPT. 28, 2017 | SCALE: 1/16" = 1'-0" | SHEET: **BAS-A-2001**

ABBREVIATIONS

GENERAL

TBR	TACTILE BRAILLE
WAF	WAYFINDING
PE	PORCELAIN ENAMEL

MAP PANELS

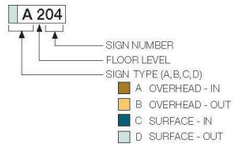
PORCELAIN ENAMEL PANELS

AP	ART PANEL
BP	BLANK PANEL
B	BUS ROUTE
CR	COMMUTER RAIL
FP	FARE POSTER
IP	INTERPRETIVE PANEL
LSA	LINE OF SYSTEM
LSI	LINE OF SYSTEM IN
LSO	LINE OF SYSTEM OUT
N	NEIGHBORHOOD
NB	NEIGHBORHOOD BUS
RTL	RAPID TRANSIT LINES
YAH	YOU ARE HERE
YAHB	YOU ARE HERE BUSWAY
	DISPLAY CASE
PMP	PERFORATED METAL PANEL

WAYFINDING SIGNAGE

SIGN PLAN SYMBOL

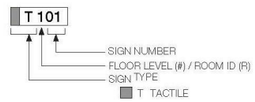
SIGN TYPE KEY



TACTILE / BRAILLE SIGNAGE

SIGN PLAN SYMBOLS

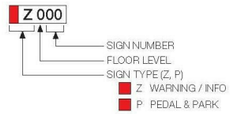
SIGN TYPE KEY



WARNING / INFORMATIONAL SIGNAGE

SIGN PLAN SYMBOL

SIGN TYPE KEY



SUBWAY

GREEN LINE

PANTONE 348 C

100C 0M 85Y 24K

CUSTOMER ASSISTANCE AREA

CAA

WHITE / 70% BLACK

0C 0M 0Y 0K / 0C 0M 0Y 70K

DROP-OFF / PICK-UP

THE RIDE

PANTONE 1235 C / BLACK

0C 24M 94Y 0K / 0C 0M 0Y 100K

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

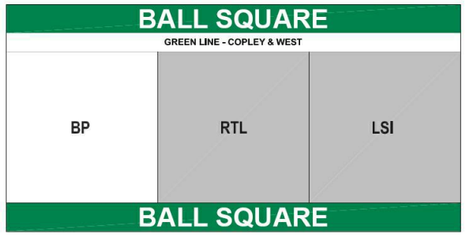
BALL SQUARE STATION
SIGNAGE INDEX

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET: **BAS-A-9001**

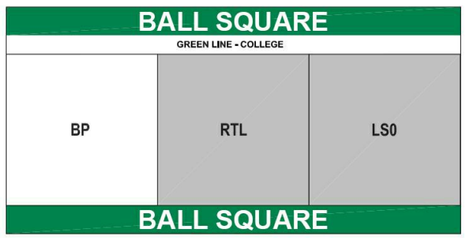
C SURFACE - IN

SCALE: 1/2" = 1'-0"

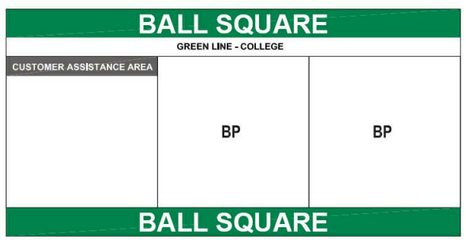
C 102
L: 144"
H: 9"
+ 6"
+ 48"
+ 9"



C 103
L: 144"
H: 9"
+ 6"
+ 48"
+ 9"



C 104
L: 144"
H: 9"
+ 6"
+ 48"
+ 9"



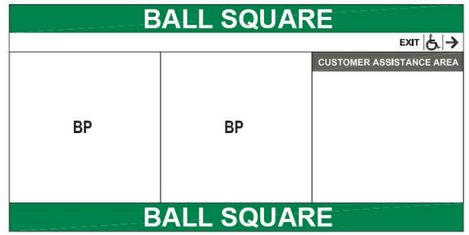
C 105
L: 120"
H: 9"
+ 6"

C 106
L: 120"
H: 9"
+ 6"

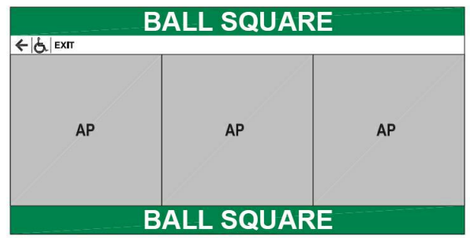
D SURFACE - OUT

SCALE: 1/2" = 1'-0"

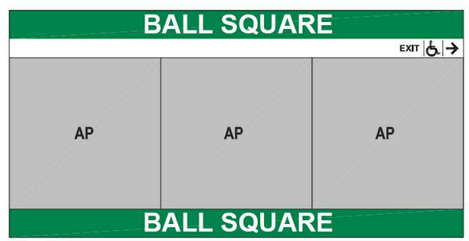
D 102
L: 144"
H: 9"
+ 6"
+ 48"
+ 9"



D 103
L: 144"
H: 9"
+ 6"
+ 48"
+ 9"



D 104
L: 144"
H: 9"
+ 6"
+ 48"
+ 9"



SIGN SCHEDULE							
NUMBER	L	H	QTY.	ELEV ATION	REFEREN CE PAGE	ATTACHMENT	REMARKS
			35				
A - OVERHEAD IN							
A101	14' - 6"	9"	1	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
A104	6' - 4"	6"	2	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
A105	13' - 10"	6"	1	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
B - OVERHEAD OUT							
B101	13' - 10"	6"	2	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
B102	10' - 0"	6"	1	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
C - SURFACE IN							
C102	12' - 0"	9"	2	N/A	SI-1401		
C103	12' - 0"	9"	1	N/A	SI-1401		
C104	12' - 0"	9"	1	N/A	SI-1401		
C105	10' - 0"	9"	3	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
C106	10' - 0"	9"	3	N/A	SI-1401	TO BE ATTACHED TO POLE SYSTEM	
D - SURFACE OUT							
D102	12' - 0"	9"	1	N/A	SI-1401		
D103	12' - 0"	9"	2	N/A	SI-1401		
D104	12' - 0"	9"	2	N/A	SI-1401		
P - PEDAL & PARK							
P101	3' - 8"	6"	1	N/A	SI-3201	SST SCREWS	MOUNTED ABOVE ENTRY DOOR
P102	0' - 11"	7"	1	N/A	SI-3201	SEX BOLTS	SEE DWG 3 / BAS-SI-320
P103	1' - 4"	9"	2	N/A	SI-3201	SEX BOLTS	SEE DWG 3 / BAS-SI-3201
P104	1' - 4"	9"	2	N/A	SI-3201	SEX BOLTS	SEE DWG 3 / BAS-SI-320
P105	0' - 9"	12"	2	N/A	SI-3201	SEX BOLTS	SEE DWG 3 / BAS-SI-320
P106	2' - 0"	24"	1	N/A	SI-3201	SEX BOLTS	SEE DWG 3 / BAS-SI-320
P108	2' - 0"	13"	1	N/A	SI-3201	SST SCREWS	ATTACHED PICKETS ON THE INSIDE FACE OF DOOR
P109	2' - 0"	13"	1	N/A	SI-3201	SST SCREWS	ATTACHED PICKETS ON THE INSIDE FACE OF DOOR
Z - WARNING / INFORMATIONAL							
Z101	0' - 7"	7"	3	N/A	SI-1401	ATTACHMENT VARIES	ALUMINUM
Z103	1' - 10"	11"	8	N/A	SI-1401	MOUNTED TO INTERTRACK, OR ROW FENCE	ALUMINUM
Z105	2' - 0"	8"	1	N/A	SI-1401	MOUNTED TO EMERGENCY EGRESS GATE	ALUMINUM
Z106	1' - 6"	18"	2	N/A	SI-1401	MOUNTED TO POLE SYSTEM	ALUMINUM

Grand total: 82

A OVERHEAD - IN

SCALE: 1/2" = 1'-0"

A 101
L: 174"
H: 9"
+ 6"

A 104
L: 76"
H: 6"

A 105
L: 165.5"
H: 6"

B OVERHEAD - OUT

SCALE: 1-1/2" = 1'-0"

B 101
L: 174"
H: 6"

B 102
L: 120"
H: 6"

Z WARNING / INFORMATIONAL

SCALE: 1/2" = 1'-0"

Z 101
L: 7"
H: 7"

Z 102
L: 14"
H: 11"

Z 105
L: 24"
H: 8"

Z 103
L: 22"
H: 29"

Z 106
L: 18"
H: 18"

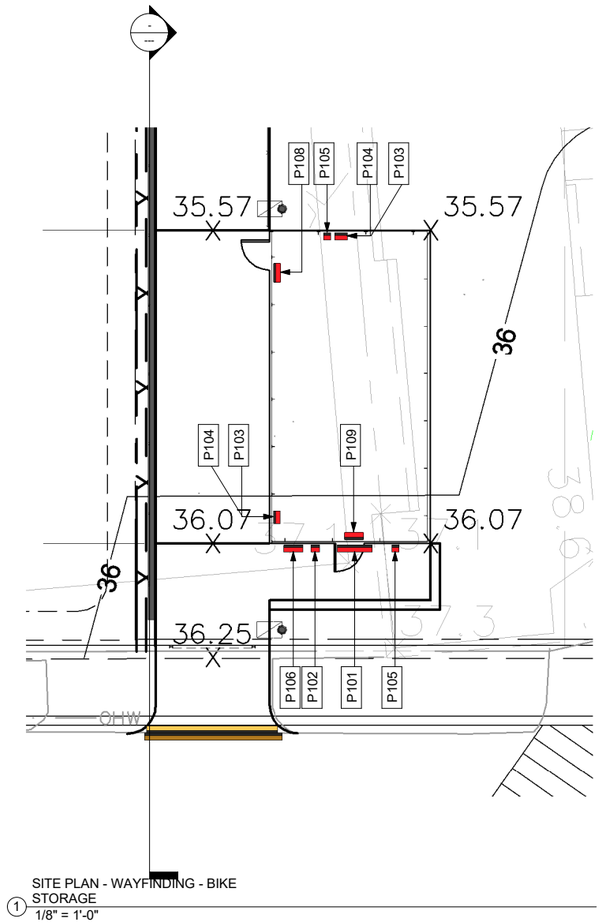
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION
WAF SIGN ELEVATIONS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **BAS-A-9002**



SITE PLAN - WAYFINDING - BIKE STORAGE
1/8" = 1'-0"

P PEDAL & PARK

SCALE: 1-1/2" = 1'-0"

P 101
L: 44"
H: 6"

PEDAL & PARK

P 102
L: 11"
H: 7"

TAP ACCESS CARD HERE
Close Door After Entry

P 103
L: 16"
H: 9"

NO LONG-TERM PARKING ALLOWED
Bicycles left at a rack or station for more than 14 days will be considered abandoned and subject to removal by MBTA. Any bicycle not properly secured at a designated rack location will be removed without notice.

P 104
L: 16"
H: 9"

DO NOT LOCK BICYCLES TO RAIL
Bicycles are subject to immediate removal by MBTA without notice. MBTA is not responsible for damage caused during removal and storage.

P 105
L: 9"
H: 12"

FACILITY IS SUBJECT TO VIDEO SURVEILLANCE
MBTA TRANSIT POLICE
Report Crime To 617-222-1212

P 106
L: 24"
H: 24"

WELCOME TO MBTA
PEDAL & PARK BIKE PARKING FACILITY

1. MBTA BICYCLE PARKING ACCESS CARD
To access this facility, please register your CharlieCard or Bike CharlieCard at: www.mbta.com/bike_tha_t/register.
2. SURVEILLANCE
Facility is continuously monitored by closed circuit security cameras and patrolled by Transit Police.
3. USE OF FACILITY AT YOUR OWN RISK
MBTA is not responsible for lost or damaged bicycles.
4. NO LONG-TERM PARKING
Bicycles left over 14 days will be removed by MBTA.
5. NO MOTORIZED VEHICLES
Including gasoline and electric mopeds or motorcycles.
6. HOURS
This facility is open during MBTA service hours.

Massachusetts Bay Transportation Authority
See Something? Say Something!
Please report bike theft and vandalism.
MBTA Transit Police 617-222-1212

P 107
L: 24"
H: 24"

EMERGENCY EXIT ONLY
ALARM WILL SOUND

P 108
L: 24"
H: 13"

EMERGENCY EXIT ONLY
ALARM WILL SOUND

P 109
L: 24"
H: 13"

EXIT HERE
CLOSE DOOR BEHIND YOU

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION
BIKE STORAGE/PEDAL & PARK SIGNAGE

DATE: SEPT. 28, 2017 | SCALE: 1/8" = 1'-0" | SHEET: **BAS-A-9003**

1. SOUTH ENTRY VIEW

2. NORTH ENTRY VIEW

3. PLATFORM VIEW

4. HEADHOUSE VIEW

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

LECHMERE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **LES-A-0101**

1. STATION ENTRY

2. PLATFORM VIEW

3. PLATFORM ENTRY VIEW

4. WALKWAY VIEW

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

EAST SOMERVILLE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **ESS-A-0101**

1. PLATFORM VIEW

2. ELEVATED WALKWAY TOWARD ELEVATOR

3. PLATFORM VIEW

4. BIKE STORAGE VIEW

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

GILMAN SQUARE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **GSS-A-0101**

1. PLATFORM ENTRY VIEW

2. PLATFORM VIEW

3. ELEVATOR VIEW

4. WALKWAY VIEW

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MAGOUN SQUARE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **MSS-A-0101**

1. PLATFORM ENTRY

2. STATION ENTRY

3. WALKWAY VIEW

4. PLATFORM VIEW

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH BARLETTA GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

BALL SQUARE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **BAS-A-0101**

1. STATION ENTRY

2. FARE VENDING MACHINES

3. PLATFORM VIEW TO EXIT

4. PLATFORM VIEW TO ENTRY

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

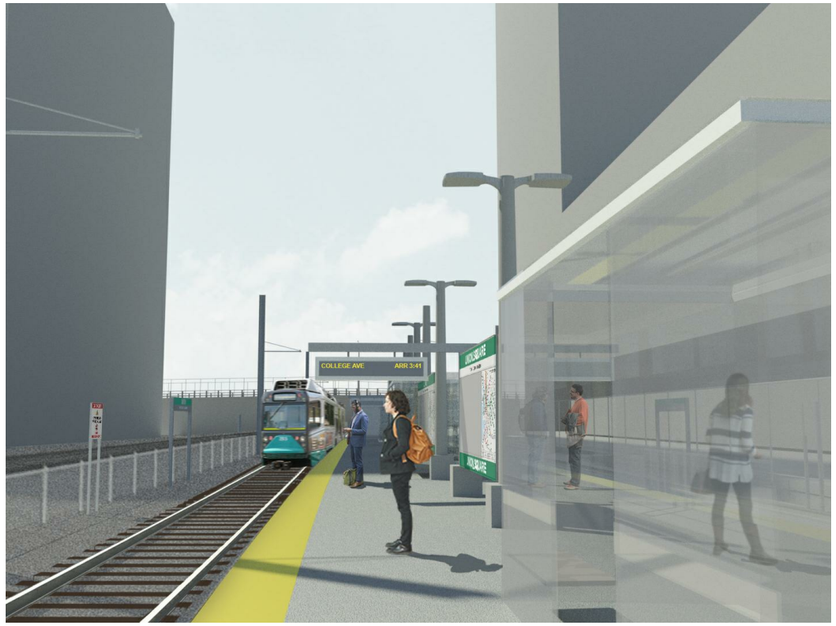
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

COLLEGE AVENUE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **COS-A-0101**

1. WALKWAY VIEW

2. PLATFORM ENTRY



3. PLATFORM VIEW TO ENTRY

4. PLATFORM VIEW TO EXIT

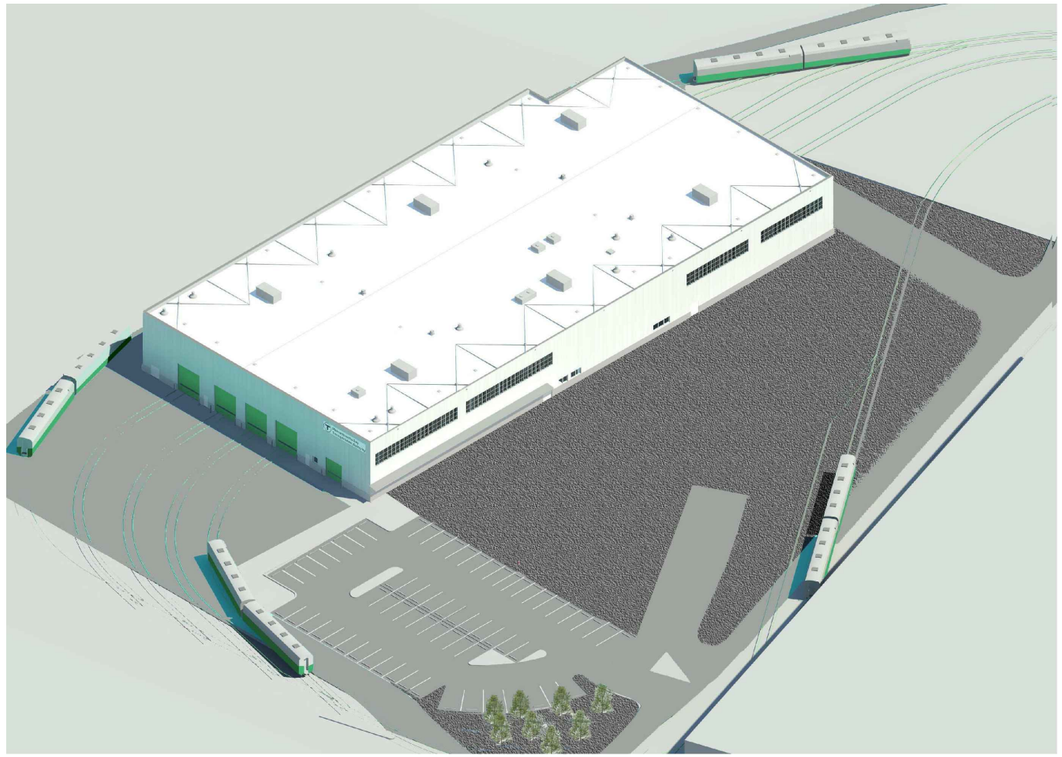
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

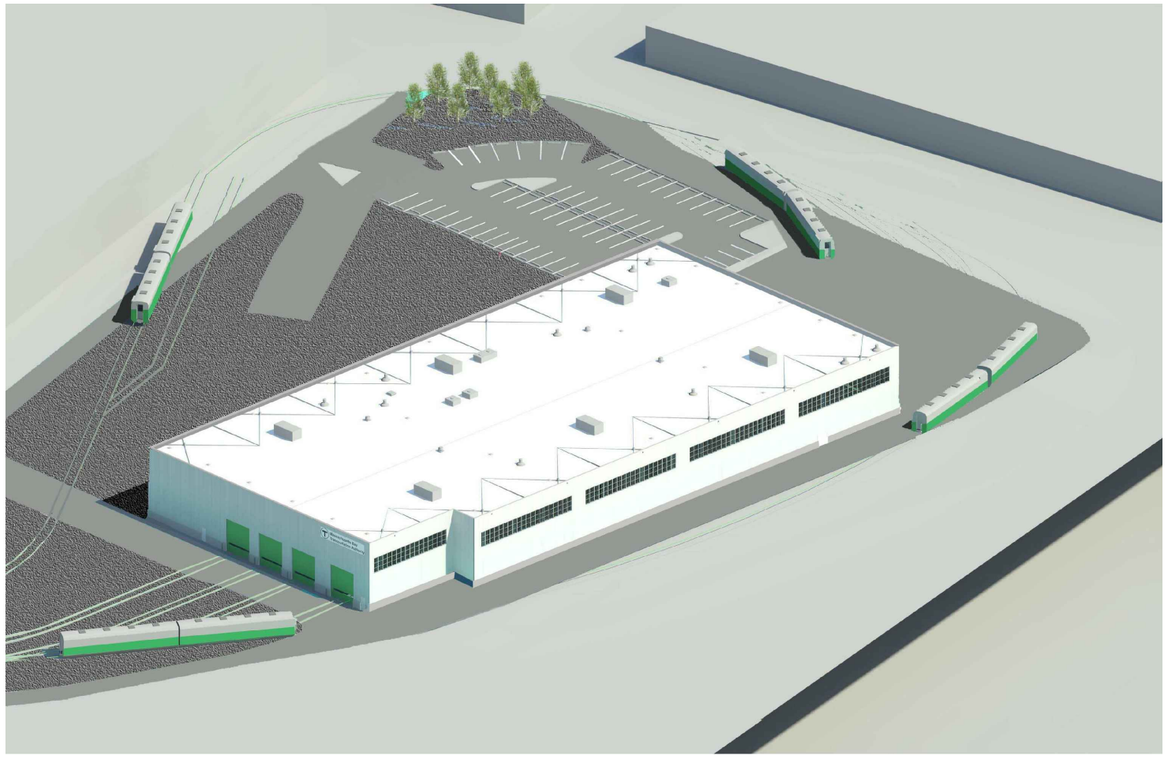
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

UNION SQUARE STATION RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET: **UNS-A-0101**



A NORTHWEST-VIEW
N.T.S.



B SOUTHEAST-VIEW
N.T.S.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY RENDERINGS

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **MAF-A-0001**

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

VEHICLE MAINTENANCE FACILITY CONTEXT PLAN - 1

DATE: SEPT. 28, 2017 | SCALE: 1:1000 | SHEET **MAF-C-1000**

MATCHLINE. SEE DWG MAF-C-2002

MEET EXIST. PAVEMENT

LANDSCAPE AREA

FOOTPRINT OF FUTURE TSP BUILDING

CURB (TYP.)

ASPHALT PAVED EMPLOYEE SEATING AREA

VERTICAL LIFT GATE W/ CARD READER

LANDSCAPE AREA

TRANSPORTATION BUILDING SURFACE PARKING (89 SPACES)

MEET EXISTING CURB

LANDSCAPE AREA

LIMIT OF VMF SITE DESIGN

CONCRETE WALKWAY

RETAINING WALL WITH FENCE. SEE YL-1 IN WALL PACKAGE.

CHAIN-LINK FENCE (TYP.)

TRANSP. BLDG.

TREE (TYP.)

CURB STOP (TYP.)

MEET EXISTING ACCESS ROADWAY

PERIMETER SECURITY FENCE

4-138

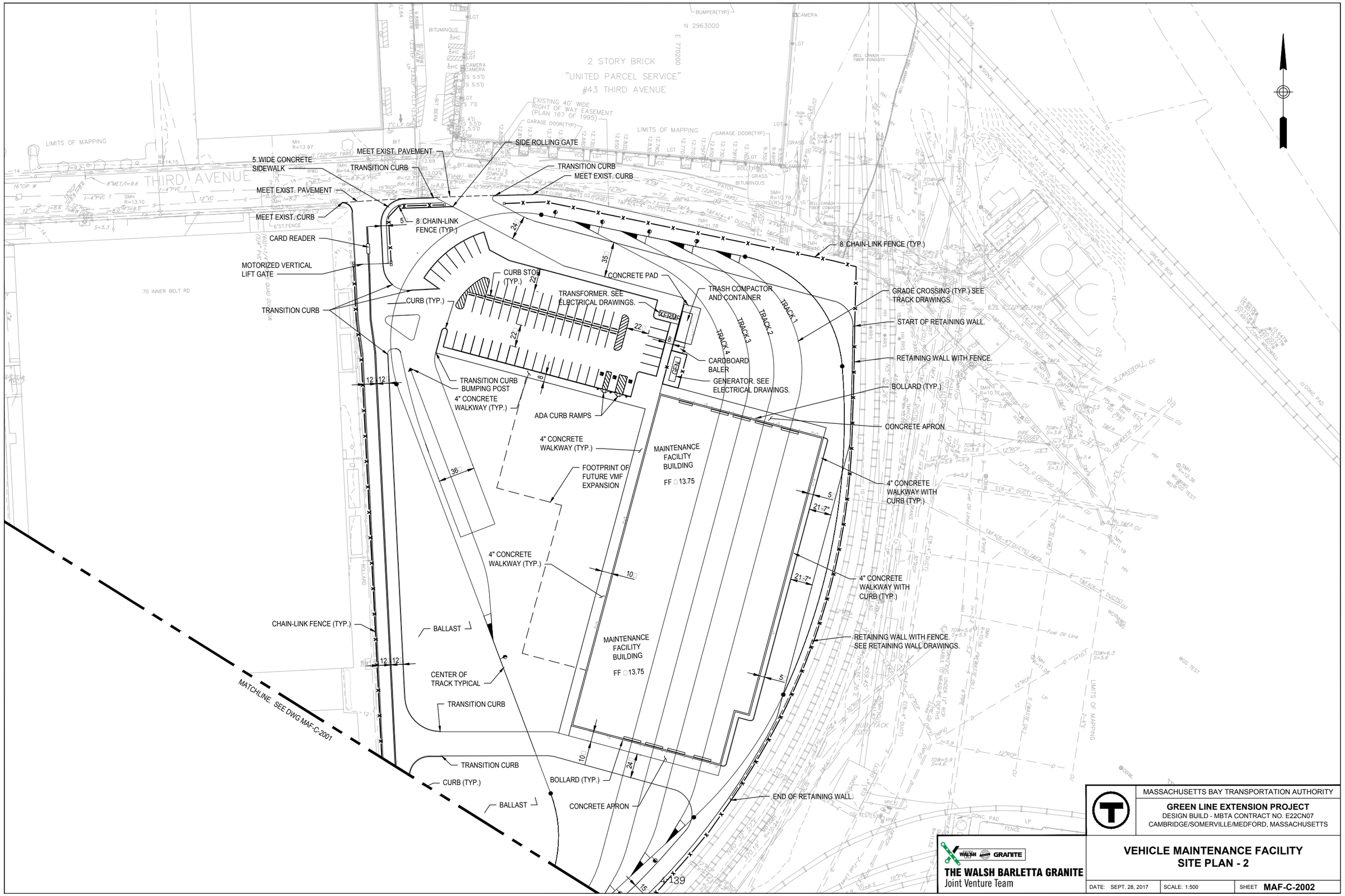
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

VEHICLE MAINTENANCE FACILITY
SITE PLAN - 1

DATE: SEPT. 28, 2017 | SCALE: 1:500 | SHEET **MAF-C-2001**



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

VEHICLE MAINTENANCE FACILITY SITE PLAN - 2

DATE: SEPT. 28, 2017 | SCALE: 1:500 | SHEET **MAF-C-2002**

MATCHLINE. SEE DWG MAF-C-2004

LIMIT OF VMF SITE DESIGN

12" Ø STORM PIPE

STORM CB
INV: 5.37

12" Ø STORM PIPE

STORM CB
INV: 3.48

12" Ø STORM PIPE

STORM CB
INV: 3.65

12" Ø PERFORATED
UNDERDRAIN (TYP.)

12" Ø STORM PIPE

STORM CB
INV: 4.14

16" Ø STORM PIPE

12" Ø STORM PIPE

STORM MH
INV: 6.00

12" Ø STORM PIPE

STORM MH
INV: 8.38

STORM MH
INV: 5.74

18" Ø STORM PIPE

STORM MH
INV: 2.75

STORM CB
INV: 1.67

16" Ø STORM PIPE

DIVERSION MANHOLE
WITH WIER
BYPASS PIPE

16" Ø STORM PIPE

STORM MH
INV: 8.00

CONC.
ENCASEMENT (TYP.)

STORM MH
INV: 1.48

STORM CB
INV: 2.43

STORM WATER
TREATMENT SYSTEM

STORM MH
INV: 1.48

CLEANOUT (TYP.)

12" Ø PERFORATED
UNDERDRAIN (TYP.)

16" Ø STORM PIPE

STORM MH
INV: 5.16

16" Ø STORM PIPE

STORM CB
INV: 3.59

24" Ø STORM PIPE

STORM CB
INV: 4.82

16" Ø STORM PIPE

EXISTING MH
42" INV OUT: 0.4'

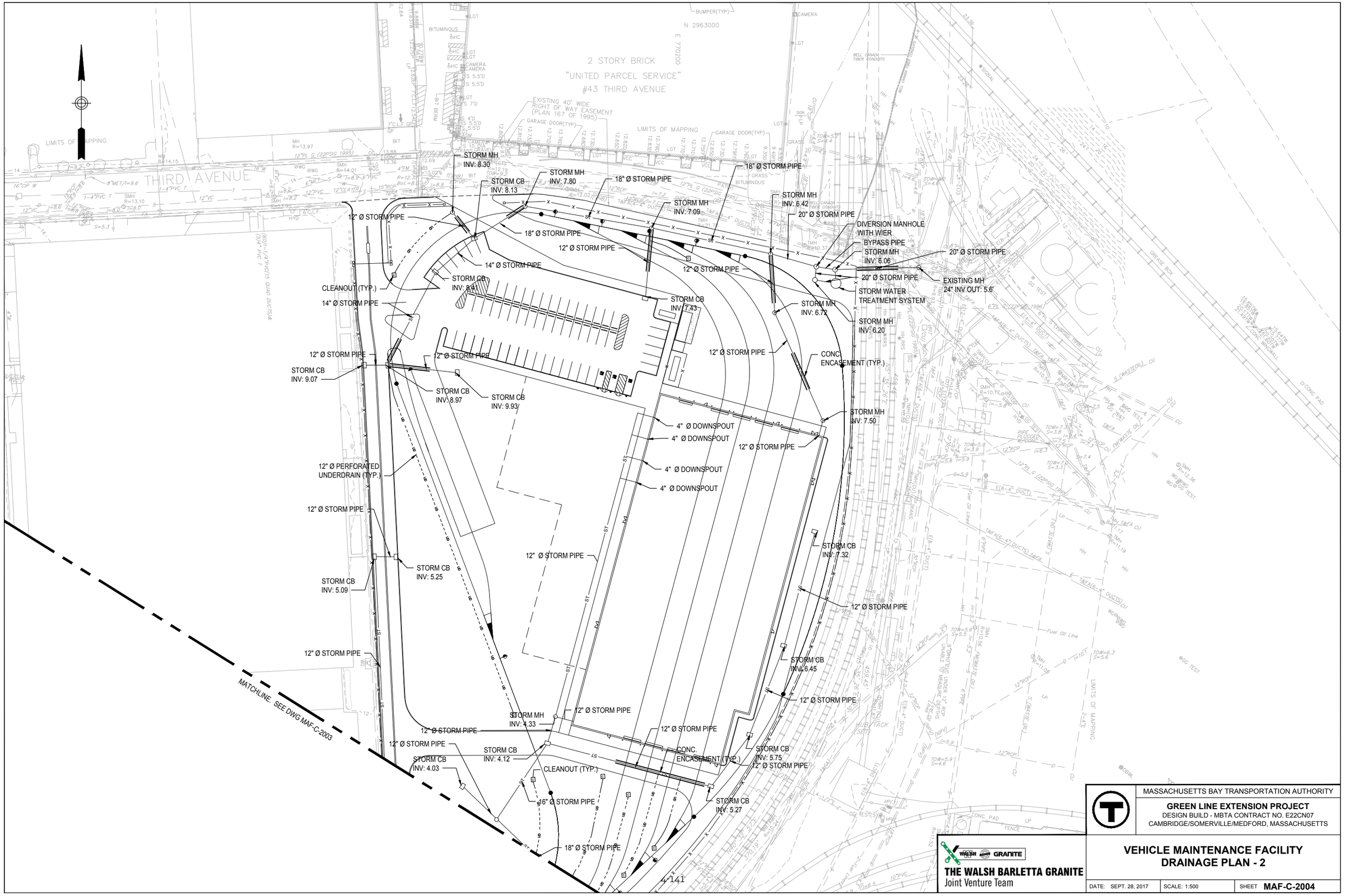
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

VEHICLE MAINTENANCE FACILITY
DRAINAGE PLAN - 1

DATE: SEPT. 28, 2017 | SCALE: 1:500 | SHEET **MAF-C-2003**



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

VEHICLE MAINTENANCE FACILITY
DRAINAGE PLAN - 2

DATE: SEPT. 28, 2017 | SCALE: 1:500 | SHEET **MAF-C-2004**

MATCHLINE. SEE DWG MAF-U-2002

4" Ø GAS LINE (TYP.)

6" Ø FIRE WATER LINE

4" Ø SANITARY PIPE

SANITARY MH
RIM: 12.50'
INV: 7.6'

CONNECT TO EXISTING WATER LINE

6" Ø WATER LINE

SANITARY MH
RIM: 12.50'
INV: 8.93'

EXISTING MH
INV OUT = 10.5'

FIRE HYDRANT WITH
BOLLARD PROTECTION

8" Ø FIRE WATER LINE (TYP.)

LIMIT OF VMF SITE DESIGN

4" Ø SANITARY PIPE

PUMP AND LIFT STATION
RIM: 12.75'
INV: 6.6'

SANITARY RELIEF MH
RIM: 13.75'
INV: 11.35'

4" Ø SANITARY PIPE

INV OUT: 9.5'

CASING SLEEVE

6" Ø FIRE WATER LINE

GAS METER AND
REGULATOR

CASING SLEEVE

FIRE HYDRANT

FIRE HYDRANT WITH
BOLLARD PROTECTION

FIRE HYDRANT WITH
BOLLARD PROTECTION

FIRE HYDRANT WITH
BOLLARD PROTECTION

8" Ø FIRE WATER LINE (TYP.)

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

VEHICLE MAINTENANCE FACILITY
UTILITY PLAN - 1

DATE: SEPT. 28, 2017 | SCALE: 1:500 | SHEET **MAF-U-2001**

PUMP AND LIFT STATION
RIM: 12.8'
INV. IN: 2.87'

NEW SERVICE CONNECTION TO EXISTING GAS LINE

EXISTING MH
BOT = 8.0'
15" INV OUT = 8.6'

8" Ø SANITARY PIPE

SANITARY RELIEF MH
RIM: 12.83'
INV: 8.90'

CONCRETE ENCASEMENT

6" Ø SANITARY FORCE MAIN

CONNECT TO EXISTING WATER LINE

6" Ø WATER LINE

6" Ø FIRE WATER LINE

CASING SLEEVE

CASING SLEEVE

FIRE HYDRANT WITH BOLLARD PROTECTION

8" Ø SANITARY PIPE

4" Ø GAS LINE (TYP.)

CASING SLEEVE

8" Ø SANITARY PIPE

SANITARY MH
RIM: 12.83'
INV: 3.57'

CASING SLEEVE

SANITARY MH
RIM: 12.83'
INV: 4.32'

CONCRETE ENCASEMENT

4" Ø SANITARY PIPE

OIL WATER SEPERATOR

FIRE HYDRANT WITH BOLLARD PROTECTION

FIRE HYDRANT WITH BOLLARD PROTECTION

GAS METER AND REGULATOR WITH BOLLARDS

INV OUT: 4.75'

CASING SLEEVE
INV OUT: 4.75'

8" Ø FIRE WATER LINE

4" Ø GAS LINE (TYP.)

8" Ø FIRE WATER LINE (TYP.)

4" Ø GAS LINE (TYP.)

MATCHLINE. SEE DWG MAF-U-2001

FIRE HYDRANT WITH BOLLARD PROTECTION

CASING SLEEVE

CASING SLEEVE

FIRE HYDRANT WITH BOLLARD PROTECTION

2 STORY BRICK
"UNITED PARCEL SERVICE"
#43 THIRD AVENUE

THIRD AVENUE

LIMITS OF MAPPING

N 2963000
E 770200

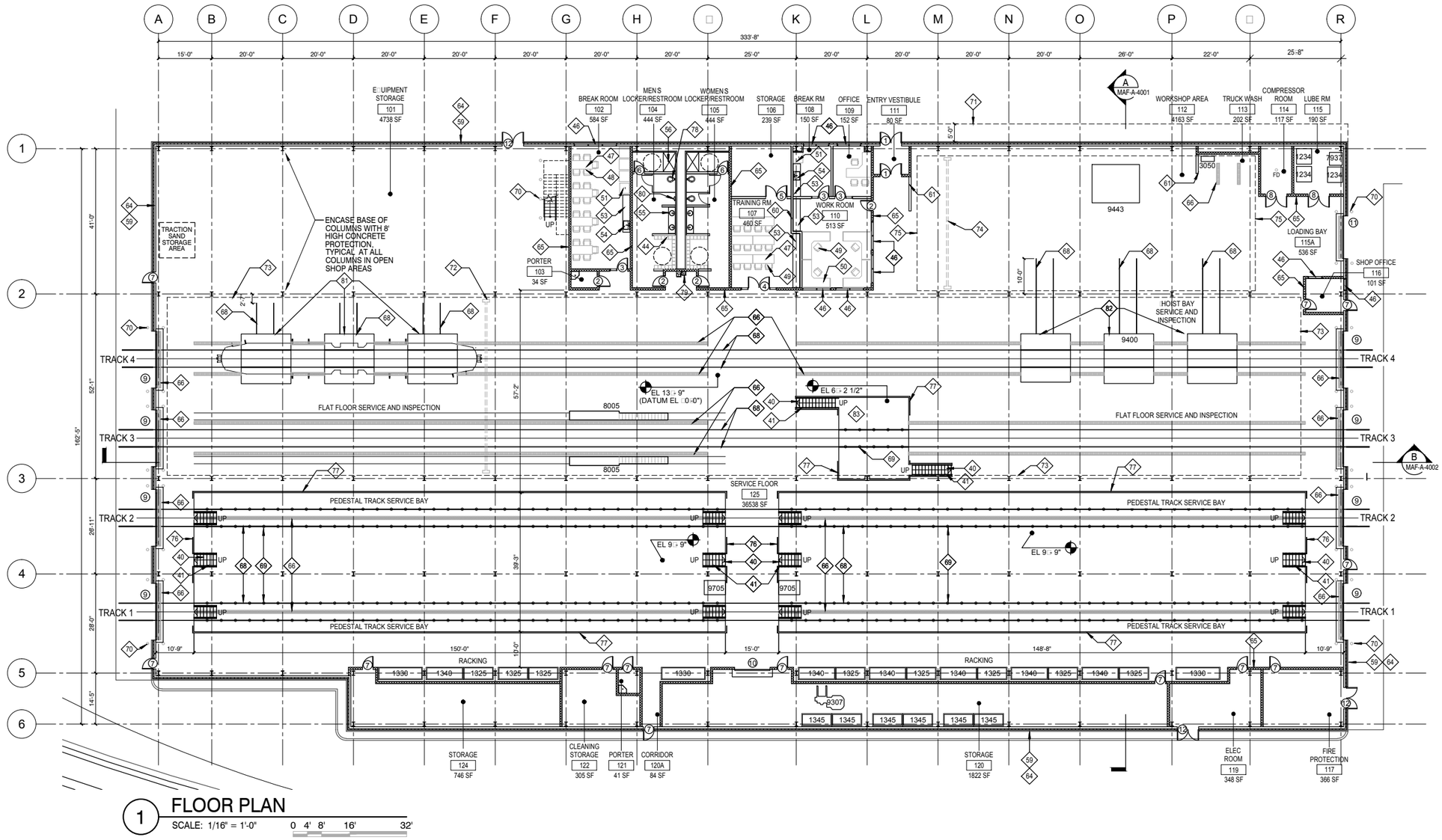
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

VEHICLE MAINTENANCE FACILITY
UTILITY PLAN - 2

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: 1:500 | SHEET **MAF-U-2002**



1 FLOOR PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

EQUIPMENT SCHEDULE

SEE DRAWING MAF-A-2101 FOR EQUIPMENT SCHEDULE AND LAYOUT.

KEYNOTE LEGEND

40	CAST IN PLACE CONCRETE STAIRS
41	STAINLESS STEEL HANDRAIL
44	LOCKERS
46	OPERABLE WINDOW
47	TABLE
48	CHAIRS
49	TASK CHAIR
50	DESK
51	REFRIGERATOR - FULL SIZE
53	CASEWORK WITH SOLID SURFACE COUNTER
54	KITCHEN SINK WITH SOLID SURFACE COUNTER
55	RESTROOM SINK WITH SOLID SURFACE COUNTER
56	SHOWER
59	4'-0" TALL BASE PERIMETER INSULATED PRECAST CONCRETE WALL
60	METAL STUD PARTITION WALL, WITH ABUSE-RESISTANT GYP BD ON BOTH SIDES
61	6'-0" TALL CMU WALL
64	INSULATED EXTERIOR METAL WALL SYSTEM
65	CMU WALL
66	TRENCH DRAIN
68	TRACK
69	ELEVATED TRACK POST
70	BOLLARD - GALVANIZED STEEL, PAINTED
71	CANOPY ABOVE
72	10 TON CRANE, ABOVE
73	EXTENT OF 10 TON CRAVE COVEARAGE
74	7.5 TON CRANE, ABOVE
75	EXTENT OF 7.5 TON CRANE COVERAGE
76	GUARDRAIL - ALUMINUM
77	REMOVABLE GUARDRAIL - ALUMINUM
78	TOILET
79	DRINKING FOUNTAIN
80	URINAL
81	HOIST PIT
82	HOIST PIT AND HOIST EQUIPMENT
83	WHEEL TRUING PIT
84	LADDER WITH SAFETY CAGE AND ROOF ACCESS HATCH

DOOR SCHEDULE

NO.	DOOR DESCRIPTION
1	(2) 3'-0" (W) X 8'-0" (H) PAINTED METAL DOOR WITH GLASS VISION PANEL, INSULATED
2	3'-0" (W) X 7'-0" (H) PAINTED METAL DOOR
3	3'-0" (W) X 7'-0" (H) PAINTED METAL DOOR WITH 18" WIDE, FULL HEIGHT SIDELIGHT
4	(2) 3'-0" (W) X 7'-0" (H) PAINTED METAL DOOR WITH 18" WIDE, FULL HEIGHT SIDELIGHT
5	(2) 3'-0" (W) X 7'-0" (H) PAINTED METAL DOOR
6	3'-0" (W) X 7'-0" (H) PHENOLIC RESIN DOOR
7	3'-0" (W) X 8'-0" (H) PAINTED METAL DOOR, INSULATED
8	(2) 3'-0" (W) X 7'-0" (H) PAINTED METAL DOOR
9	17'-0" (W) X 18'-0" (H) (H) HIGH SPEED INSULATED COILING OVERHEAD PAINTED METAL SERVICE DOOR
10	10'-0" (W) X 10'-0" (H) HIGH SPEED INSULATED COILING OVERHEAD PAINTED METAL SERVICE DOOR
11	12'-0" (W) X 14'-0" (H) HIGH SPEED INSULATED COILING OVERHEAD PAINTED METAL SERVICE DOOR
12	(2) 3'-0" (W) X 8'-0" (H) PAINTED METAL DOOR, INSULATED

SYMBOLS LEGEND

ROOM KEY:
ROOM NAME
ROOM NUMBER
NET SQUARE FOOTAGE
ROOM NAME 101 150 SF

ELEV 10'-0" SPOT ELEVATION KEY

FD FLOOR DRAIN

KEYNOTE TAG

DOOR TAG

COLUMN GRID LINE INDICATORS 0 0

MILLWORK, FURNITURE & FURNISHINGS

- BREAK ROOM 102: COUNTER TOP, UPPER AND LOWER CABINETS, SINK WITH DISPOSAL, MICROWAVES, FULL-HEIGHT REFRIGERATOR, WATER COOLER, TABLES, CHAIR, AND CORKBOARD.
- PORTER 103: 8'-0" x 1'-0" x 3/4" WALL MOUNTED PLASTIC LAMINATE SHELF ON BRACKETS.
- MEN'S LOCKER/RESTROOM 104: TOILET, TOILET PARTITIONS,TOILET PAPER DISPENSER, URINAL, URINAL SCREENS, SINKS, MIRRORS, HANDS-FREE HAND DRYERS, SOAP DISPENSERS, SHOWER, LOCKERS, BENCH, RECEPTACLES, AND ROBE HOOKS.
- WOMEN'S LOCKER/RESTROOM 105: TOILETS, TOILET PARTITIONS, TOILET PAPER DISPENSERS, SINKS, MIRRORS, HANDS-FREE HAND DRYERS, SOAP DISPENSERS, SHOWER, LOCKERS, BENCH, SANITARY NAPKIN DISPENSERS AND DISPOSAL, RECEPTACLES, AND ROBE HOOKS.
- STORAGE ROOM 106: 12'-0" x 1'-0" x 3/4" WALL MOUNTED PLASTIC LAMINATE SHELF ON BRACKETS.
- TRAINING ROOM 107: (12) FOLDING CHAIRS, (6) 5'-0" x 2'-0" FOLDING TABLES, 60" WALL MOUNTED 1080 DPI, 60Hz (MIN.) TELEVISION WITH WIRED, AV INPUT AND HDMI CAPABILITY, 12'-0" (MIN. LENGTH) x 2'-0" DEEP, BUILT-IN MILLWORK BASE CABINET AND COUNTER TOP.
- BREAKROOM 108: 8'-0" x 2'-0" COUNTER SPACE, UPPER AND LOWER CABINETS, SINK WITH DISPOSAL, MICROWAVE, FULL-SIZE REFRIDGERATOR (24 CUBIC FEET MINIMUM), WATER COOLER, (2) 5'-0" x 2'-0" TABLES, (6) CHAIRS, AND 5'-0" x5'-0" WALL MOUNTED CORK PIN-UP BOARD
- OFFICE 109: SWIVEL TASK CHAIR, TWO (2) GUEST CHAIRS, L-SHAPED 5'x5', (LONG) x 24" DEEP OFFICE DESK, 3'-0" DEEP, DOUBLE TIER, LEGAL SIZE, UNDER COUNTER LOCKABLE METAL FILING CABINET.
- WORK ROOM 110: 12'-0" (MIN. LENGTH) x 2'-0" DEEP, BUILT-IN MILLWORK BASE CABINET AND COUNTER TOP. OPERABLE WINDOW SHADES. FOUR (4) L-SHAPE 8'-0" x 8'-0" WORKSTATIONS WITH UNDER COUNTER PEDESTAL AND LATERAL METAL FILING CABINETS. FOUR (4) SWIVEL TASK CHAIRS.
- TRUCK WASH AREA: 113: HIGH PRESSURE WASHER WITH REMOTE WASH WAND WITH SCABBARD, PUSH BUTTON CONTROLS, AND HOSE REELS. SOAP DRUM. ACCESS TO CRANE. COORDINATE WITH EQUIPMENT LIST ON MAF-EQ-2101.
- SHOP OFFICE 116: SWIVEL TASK CHAIR, L-SHAPED 5' x 5', (LONG) x 24" DEEP OFFICE DESK, 3'-0" DEEP, DOUBLE TIER, LEGAL SIZE, UNDER COUNTER LOCKABLE METAL FILING CABINET.
- PORTER 121: 8'-0" x 1'-0" x 3/4" WALL MOUNTED PLASTIC LAMINATE SHELF ON BRACKETS.

N

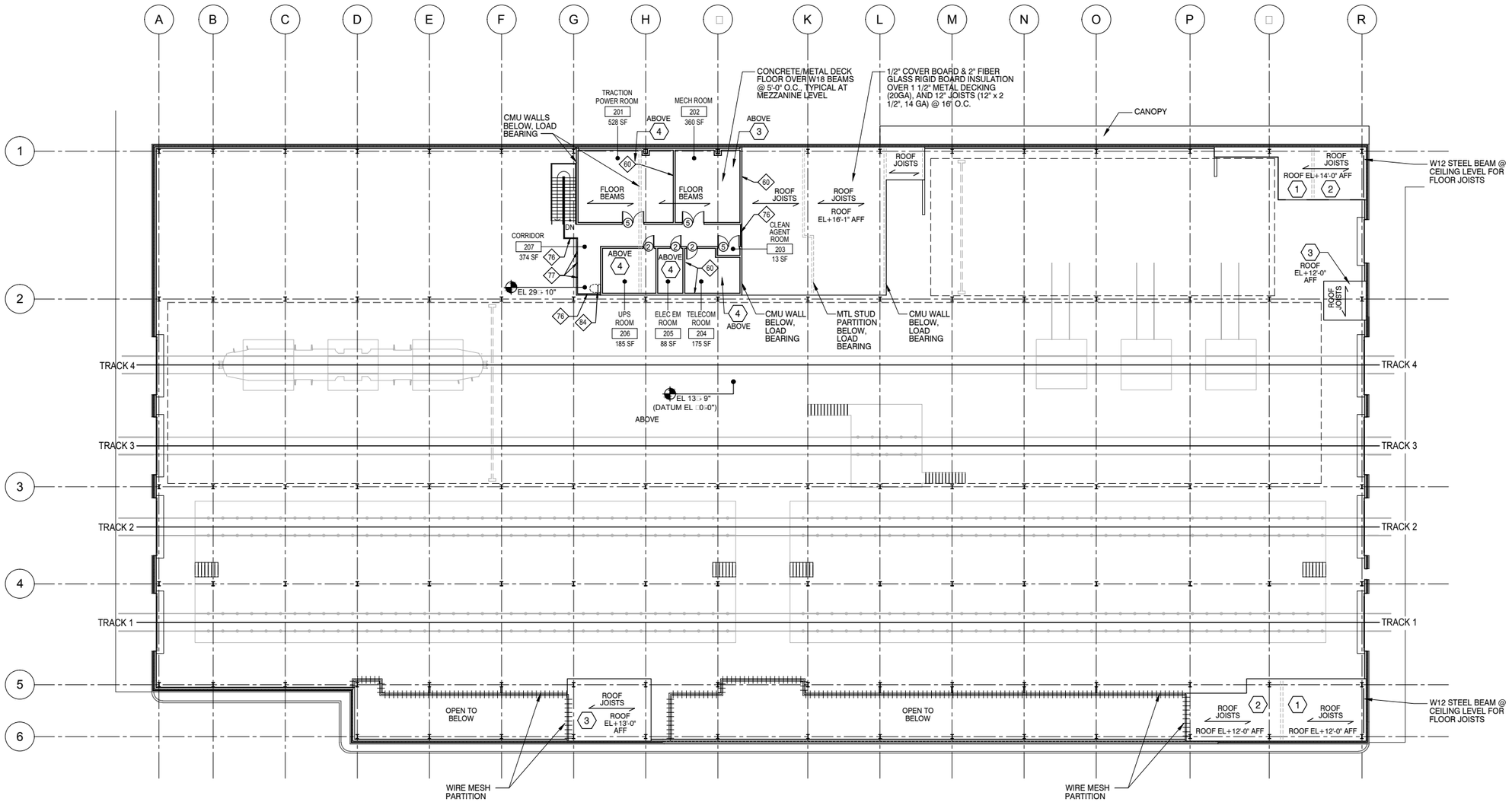
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

FLOOR AND EQUIPMENT PLAN

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MAF-A-2101



GENERAL SHEET NOTE

1. SEE DRAWING MAF-A-2101 FOR EQUIPMENT SCHEDULE, KEYNOTE LEGEND, AND DOOR SCHEDULE.

SHEET KEYNOTES (#)

1. 1-HR UL-RATED CEILING ASSEMBLY, 1 1/2" METAL DECKING (20GA) OVER 12" JOISTS (12" x 2 1/2", 14 GA) @ 16" O.C.
2. 2-HR UL-RATED CEILING ASSEMBLY, (UL DESIGN NO. K506 OR EQUAL), 1 1/2" METAL DECKING (20GA) OVER 12" JOISTS (12" x 2 1/2", 14 GA) @ 16" O.C.
3. CEILING ASSEMBLY OF 1 1/2" METAL DECKING (20GA) OVER 12" JOISTS (12" x 2 1/2", 14 GA) @ 16" O.C.
4. 2-HR UL-RATED CEILING ASSEMBLY, (UL DESIGN NO. K506 OR EQUAL), 1 1/2" METAL DECKING (20GA) OVER 12" JOISTS (12" x 2 1/2", 14 GA) @ 16" O.C.; 1/2" COVER BOARD & 2" FIBERGLASS RIGID BOARD INSULATION OVER METAL DECKING.

1 MEZZANINE LEVEL PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

N

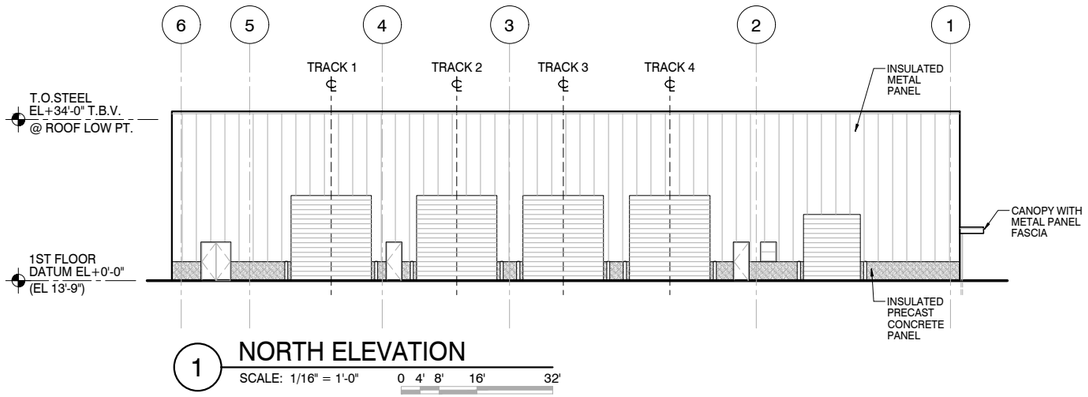
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

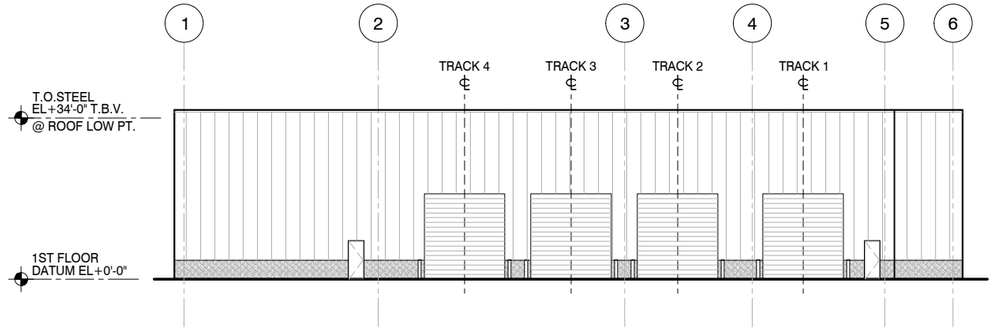
MEZZANINE LEVEL PLAN

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **MAF-A-2102**



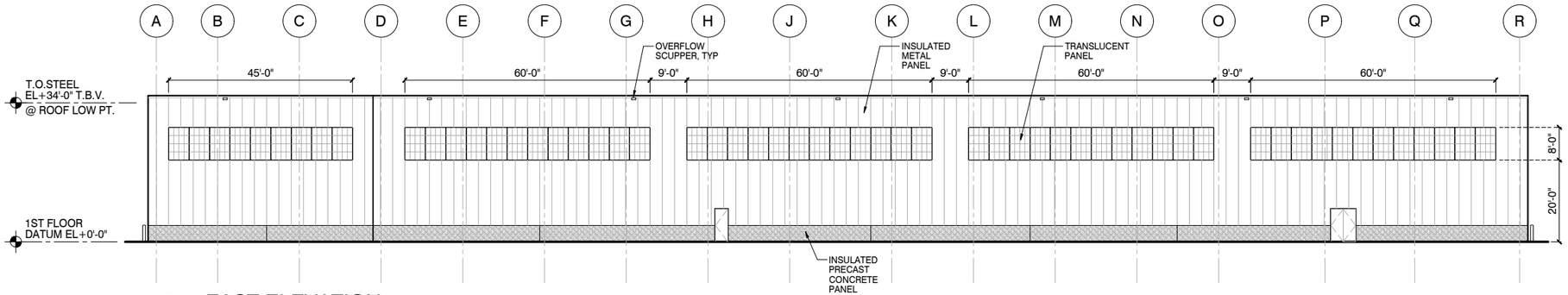
1 NORTH ELEVATION

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'



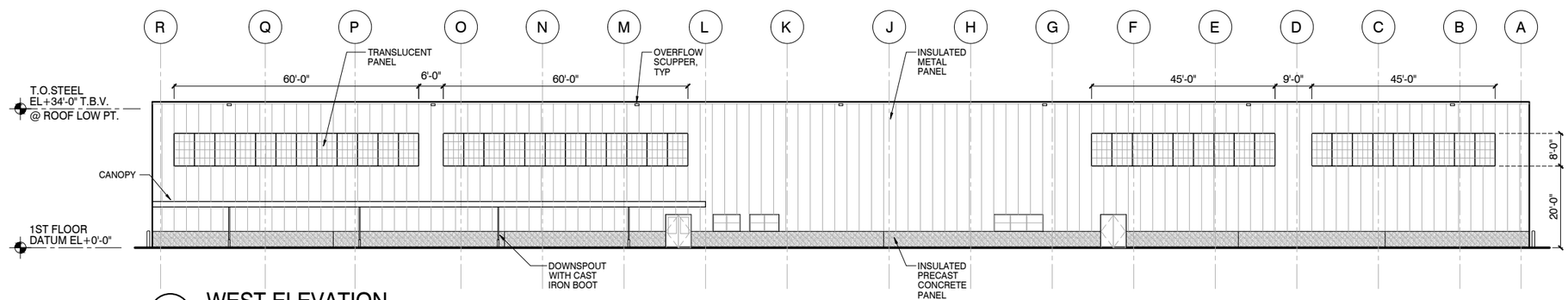
2 SOUTH ELEVATION

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'



3 EAST ELEVATION

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'



4 WEST ELEVATION

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

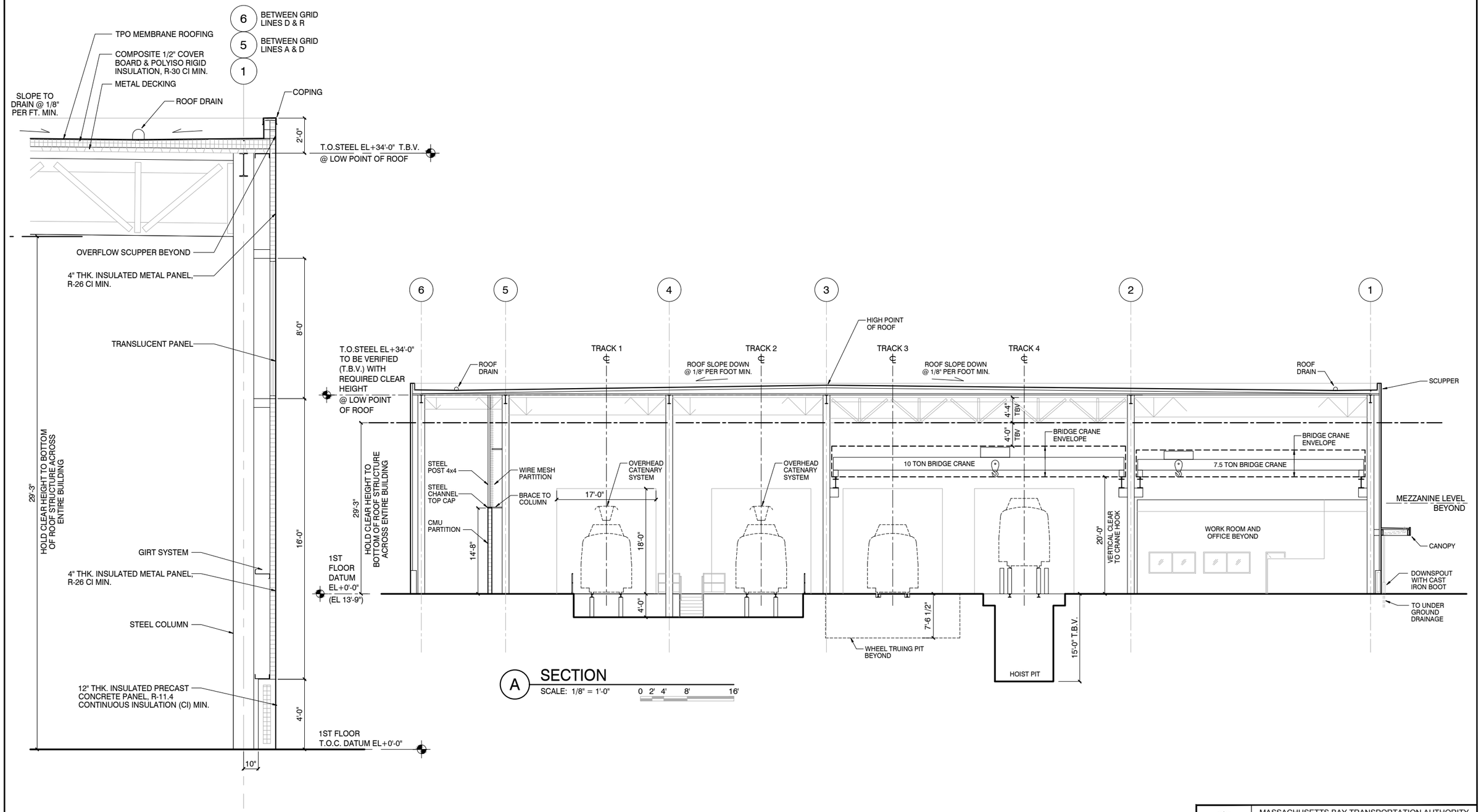
WALSH GRANITE

THE WALSH BARLETTA GRANITE

Joint Venture Team

ELEVATIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **MAF-A-3001**



A SECTION
SCALE: 1/8" = 1'-0" 0 2' 4' 8' 16'

B TYP. WALL SECTION
SCALE: 3/8" = 1'-0" 0 1' 2' 4'

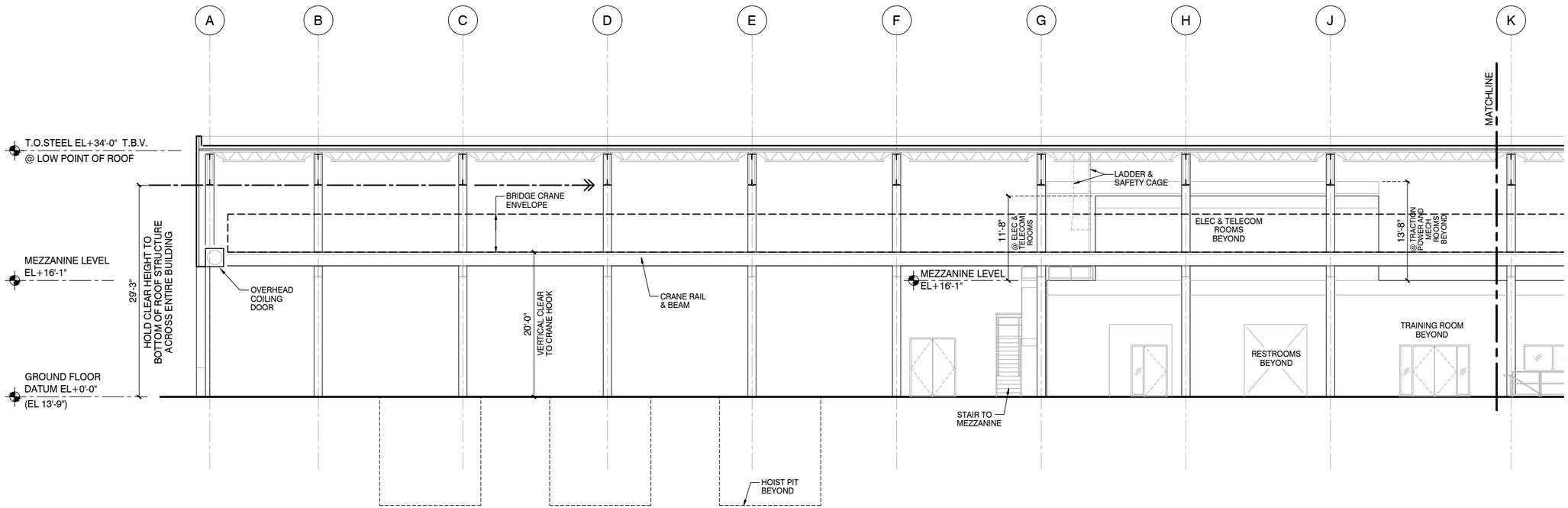
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

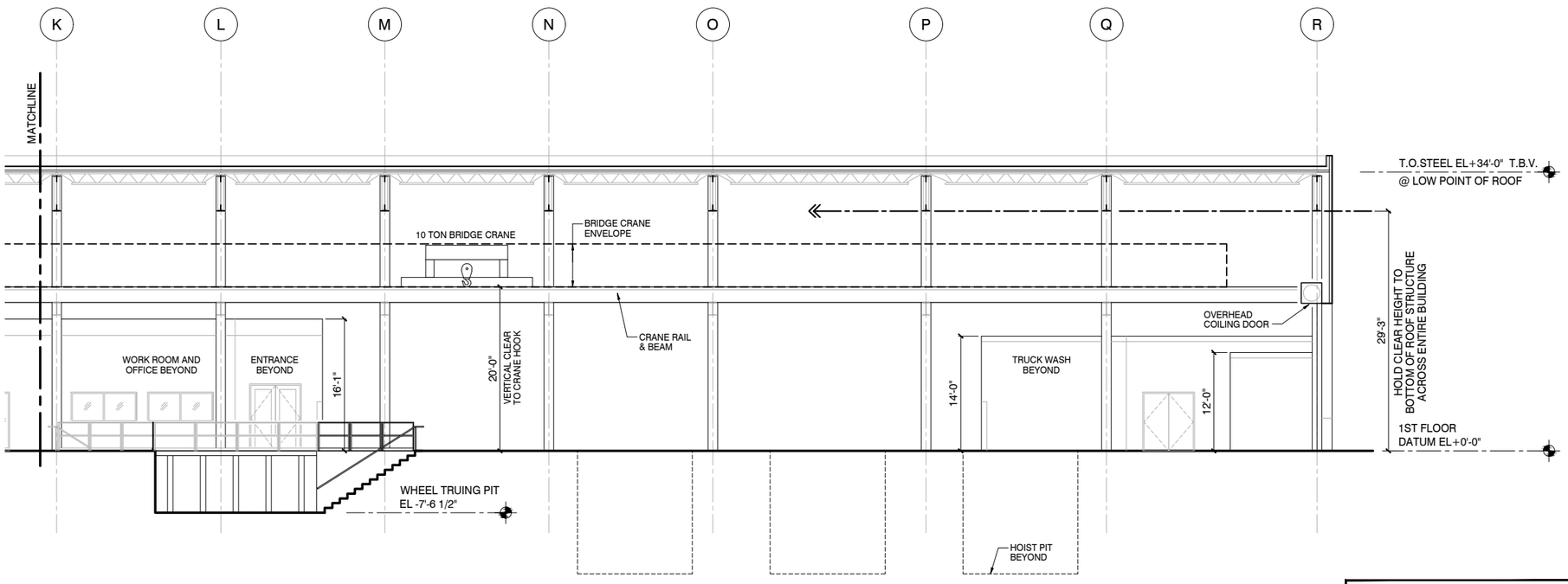
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

SECTIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **MAF-A-4001**





B SECTION

SCALE: 1/8" = 1'-0" 0 2' 4' 8' 16'

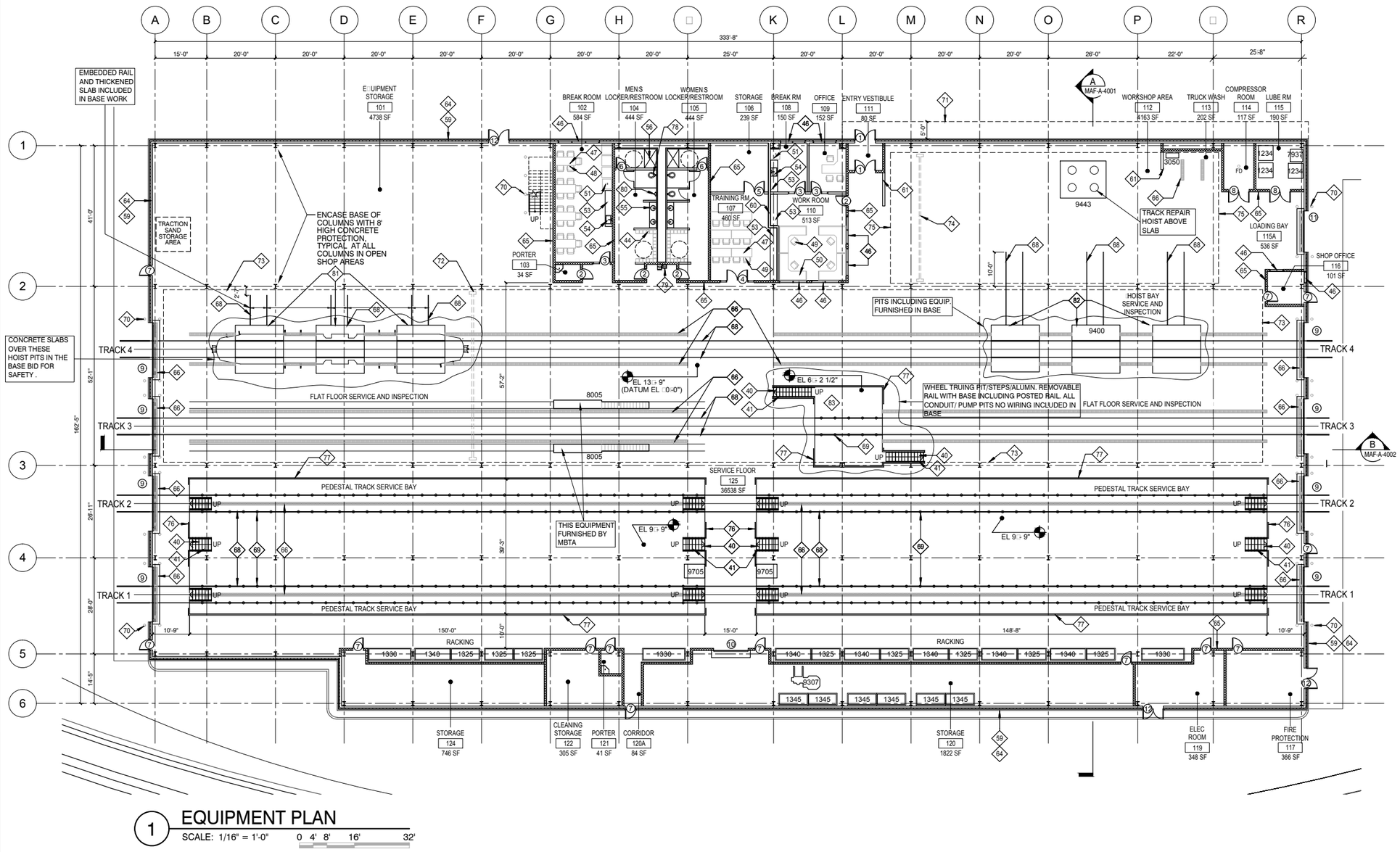
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **MAF-A-4002**



1 EQUIPMENT PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

EQUIPMENT SCHEDULE				
#	EQ ID #	NAME	TYPE	SPEC. NO.
6	1005	BOARD, PEG, TOOL	6 x 3	10670
3	1234	PALLET, SPILL CONTAINMENT 4 DRUMS	SINGLE BARREL	11140
10	1270	RACK- STORAGE- 72 BIN	72 BIN	10670
2	1290	CRUSHER, OIL FILTER		
4	1295	RACK, BULK STORAGE	2x6x6	10670
8	1325	RACK, PALLET, 3 LEVEL	8 WIDE	10670
3	1330	RACK, PALLET, 3 LEVEL	12 WIDE	10670
6	1340	RACK, PALLET, 3 LEVEL	10 WIDE	10670
6	1345	RACK, PALLET, 3 LEVEL	8 WIDE, 10 HIGH	10670
4	1511	SHELVING UNIT	18" W x 36" L x 84" H	10670
18	1516	SHELVING UNIT	18" W x 48" L x 84" H	10670
1	2123	COMPACTOR, TRASH - EXTERIOR OF BUILD	STATIONARY, 40 CY	11170
1	2129	BALER, VERTICAL RE POWER AND OIL HEATER	HEAVY DUTY	11170
1	2196	ROTARY SCREW AIR COMPRESSOR		
9	2629	VICE WITH TABLE	COMBINATION, SWIVEL BASE, 5"	11500
1	3025	TANK, PARTS CLEANING		11500
1	3050	WASHER, HIGH PRESSURE, NG	HOT WATER, NATURAL GAS	1150
2	5041	CART, DEIONIZED WATER, PORTABLE		11520-PART1
4	7522	PUMP, AIR PISTON		11140
4	7706	RECEIVER, WASTE FLUIDS 25 GAL.	WASTE OIL	11140
1	7937	TANK, WASTE COLLECTION, INTEGRAL PUMP	250 GALLONS	
8	8002	PLATFORM WORK PORTABLE		11520
#	8005	PLATFORM WORK ROOF **FURNISHED BY MBTA** - MAY NEED RAILS EMBEDDED		
9	8117	WORKBENCH SEE DRAWING	SEVERE DUTY, 6 x 32"	
1	9105	CRANE BRIDGE	TOP-RUNNING, 10 TON	14650
1	9126	CRANE BRIDGE	TOP-RUNNING, 7.5 TON	14630
1	9307	FORKLIFT ELECTRIC	NARROW AISLE	14500
1	9400	HOIST, LRV, IN-GROUND, WITH BODY STANDS, ROTATING HOISTS		14450
1	9443	HOIST TRUCK REPAIR ABOVE SLAB (NO SCISSOR LIFTS)		11140
2	9705	LIFT, PARTS, TWO STOPS SCISSOR LIFT OK. (RE , PIT)		
4	9815	PALLET ACK		11520

NOTE:
SOME LOOSE EQUIPMENT IS NOT SHOWN ON THIS DRAWING, BUT FURNISHED AS LISTED IN SCHEDULE ABOVE.

KEYNOTE LEGEND	
40	CAST IN PLACE CONCRETE STAIRS
41	STAINLESS STEEL HANDRAIL
66	TRENCH DRAIN
68	TRACK - SET OUT TRACK RE . FOR LIFT
69	ELEVATED TRACK POST
70	BOLLARD - GALVANIZED STEEL, PAINTED
72	10 TON CRANE, ABOVE
73	EXTENT OF 10 TON CRANE COVEARAGE
74	7.5 TON CRANE, ABOVE
75	EXTENT OF 7.5 TON CRANE COVERAGE
76	GUARDRAIL - ALUMINUM
77	REMOVABLE GUARDRAIL - ALUMINUM
81	HOIST PIT - PITS ONLY CAPPED OVER NO E UIPMENT
82	HOIST PIT AND HOIST E UIPMENT
83	WHEEL TRUING PIT - ONLY NO E UIPMENT
84	LADDER WITH SAFETY CAGE AND ROOF ACCESS HATCH

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MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

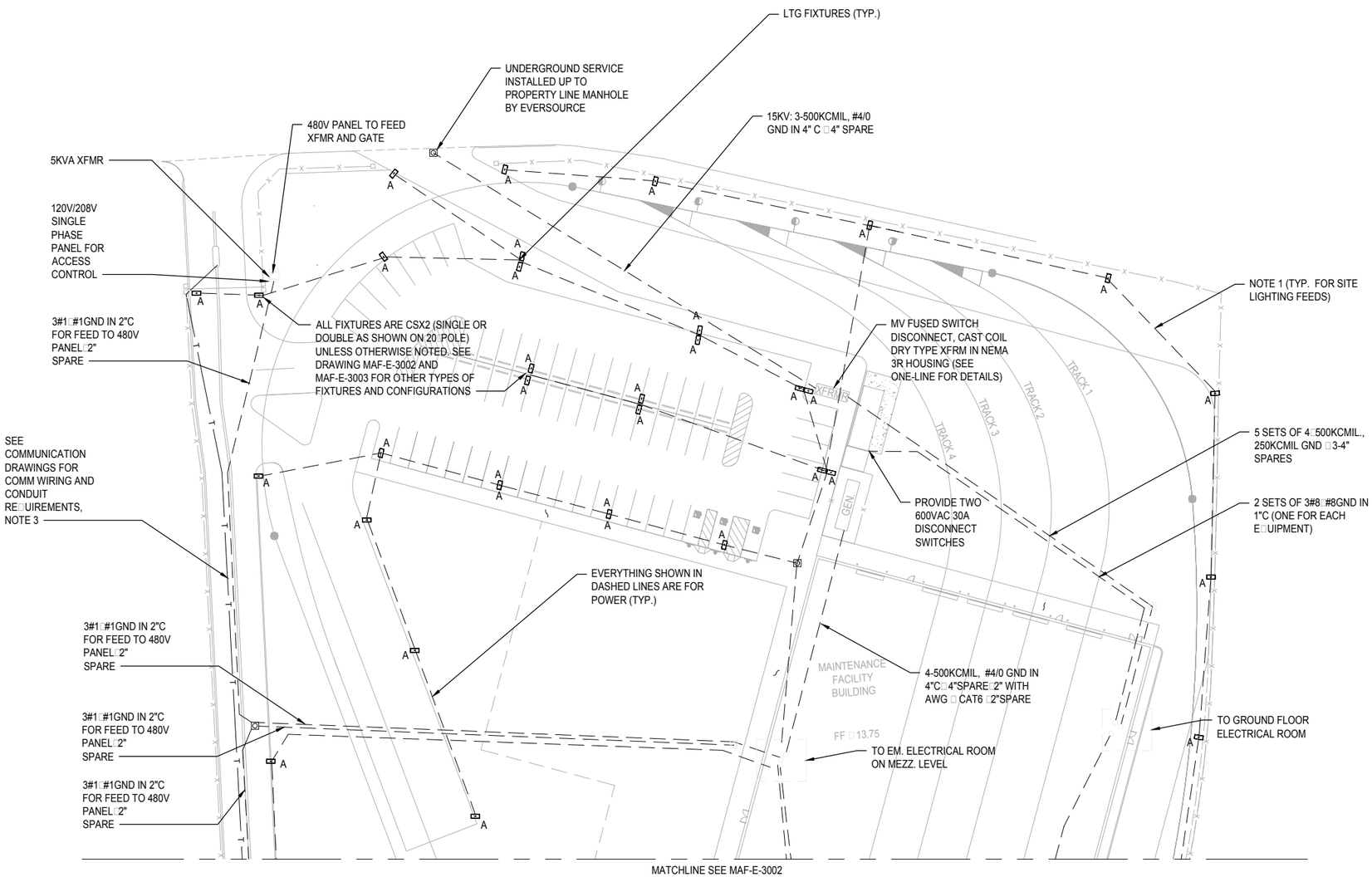
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

EQUIPMENT PLAN

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MAF-Q-2101

N


LTG FIXTURES (TYP.)
UNDERGROUND SERVICE INSTALLED UP TO PROPERTY LINE MANHOLE BY EVERSOURCE
480V PANEL TO FEED XFMR AND GATE
15KV: 3-500KCMIL, #4/0 GND IN 4" C □4" SPARE
5KVA XFMR
120V/208V SINGLE PHASE PANEL FOR ACCESS CONTROL
NOTE 1 (TYP. FOR SITE LIGHTING FEEDS)
3#1□#1GND IN 2"C FOR FEED TO 480V PANEL□2" SPARE
ALL FIXTURES ARE CSX2 (SINGLE OR DOUBLE AS SHOWN ON 20□POLE) UNLESS OTHERWISE NOTED. SEE DRAWING MAF-E-3002 AND MAF-E-3003 FOR OTHER TYPES OF FIXTURES AND CONFIGURATIONS
MV FUSED SWITCH DISCONNECT, CAST COIL DRY TYPE XFRM IN NEMA 3R HOUSING (SEE ONE-LINE FOR DETAILS)
5 SETS OF 4□500KCMIL, 250KCMIL GND □3-4" SPARES
PROVIDE TWO 600VAC 30A DISCONNECT SWITCHES
2 SETS OF 3#8□#8GND IN 1"C (ONE FOR EACH E□UIPMENT)
SEE COMMUNICATION DRAWINGS FOR COMM WIRING AND CONDUIT RE□UIREMENTS, NOTE 3
EVERYTHING SHOWN IN DASHED LINES ARE FOR POWER (TYP.)
3#1□#1GND IN 2"C FOR FEED TO 480V PANEL□2" SPARE
3#1□#1GND IN 2"C FOR FEED TO 480V PANEL□2" SPARE
3#1□#1GND IN 2"C FOR FEED TO 480V PANEL□2" SPARE
4-500KCMIL, #4/0 GND IN 4"C□4"SPARE□2" WITH AWG □ CAT6 □2"SPARE
TO GROUND FLOOR ELECTRICAL ROOM
TO EM. ELECTRICAL ROOM ON MEZZ. LEVEL
MAINTENANCE FACILITY BUILDING
FF □13.75
TRACK 1
TRACK 2
TRACK 3
TRACK 4
GEN.
MATCHLINE SEE MAF-E-3002

NOTES:

1. RUN 4" CONDUITS FOR THE SITE LIGHTING FEEDS. WIRE SIZE SHALL BE #2AWG AND □UANTITY SHALL BE BASED ON THE NUMBER OF CIRCUITS ALONG THAT RUN, LOWER WIRE SIZE SHALL BE PERMITTED IF VOLTAGE DROP OF 3□ MAX IS MAINTAINED AND DERATING FACTORS ARE TAKEN INTO ACCOUNT. THERE SHALL BE MAXIMUM 10 FIXTURES PER CIRCUIT, ALTERNATE THE CIRCUITS THAT TWO FIXTURES IN A ROW ARE ON DIFFERENT CIRCUITS. EACH CIRCUIT TO HAVE A DEDICATED NEUTRAL. FIXTURE VOLTAGE SHALL BE 277V SINGLE PHASE.
2. ALL CONDUITS SHOWN SHALL BE RUN IN SCH. 40 CONDUIT IN DUCTBANK. CONDUITS TO BE SPACED 3" FROM OUTER EDGE OF EACH OTHER AND TO THE OUTER EDGE OF DUCTBANK. DUCTBANK SHALL HAVE MINIMUM 30" COVER.
3. COMBINE NEAREST AD□ACENT CONDUIT RUNS TO FORM SINGLE DUCTBANK TO ALLOW FOR ONE TRENCH WHEREVEVR POSSIBLE.
4. PROVIDE POWER FEED TO EACH POE CABINET USING 2#8□#8GND IN 1" CONDUIT. SEE COMMUNICATION DRAWINGS FOR POE CABINET LOCATIONS. RUN CONDUITS IN DUCTBANK. MAINTAIN CONDUIT RUNS SUCH THAT IT CAN COMBINE WITH THE NEAREST AD□ACENT CONDUIT RUNS TO FORM ONE DUCTBANK OR AT MINIMUM ONE TRENCH.
5. UNLESS OTHERWISE NOTED, ALL E□UIPMENT LOCATED ON SITE SHALL BE NEMA 4X S.S.
6. ONLY MINIMAL AMOUNT OF MANHOLE AND PULLBOXES ARE SHOWN. MAXIMUM COMPOUNDED BEND PER RUN IS 360 DEGREES BETWEEN PULL POINTS.
7. ALL WIRES SHALL BE XHHW-2. ANY EXPOSED OUTDOOR CONDUITS SHALL BE PVC COATED RGS.
8. PROVIDE POWER FEED TO PUMP STATION. AT MINIMUM PROVIDE 480V FEED FOR PUMPS (3#4/0□#4GND IN 2"C) AND 120V FOR CONTROLS (2#6□#10GND IN 1"C) AND 20#12 IN 2" CONDUIT FOR CONTROLS. SEE MECH DRAWINGS FOR DETAILS.

0 30 60
SCALE IN FEET

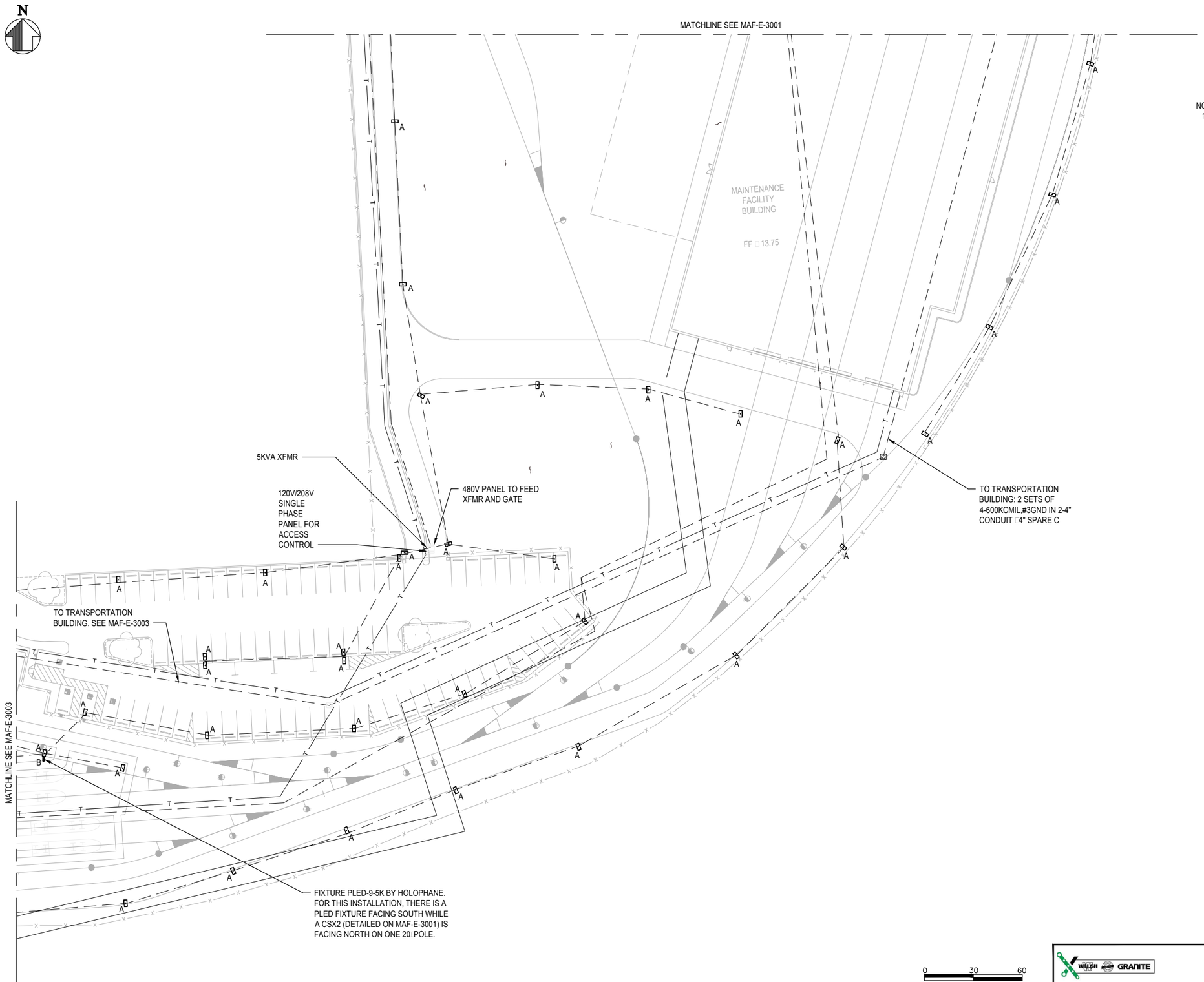
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY ELECTRICAL SITE PLAN SHEET 1

DATE: SEPT. 28, 2017 | SCALE: 1":30□ | SHEET **MAF-E-2001**


N
MATCHLINE SEE MAF-E-3001
MAINTENANCE FACILITY BUILDING
FF 13.75
5KVA XFMR
120V/208V SINGLE PHASE PANEL FOR ACCESS CONTROL
480V PANEL TO FEED XFMR AND GATE
TO TRANSPORTATION BUILDING: 2 SETS OF 4-600KCMIL,#3GND IN 2-4" CONDUIT 4" SPARE C
TO TRANSPORTATION BUILDING. SEE MAF-E-3003
MATCHLINE SEE MAF-E-3003
FIXTURE PLED-9-5K BY HOLOPHANE. FOR THIS INSTALLATION, THERE IS A PLED FIXTURE FACING SOUTH WHILE A CSX2 (DETAILED ON MAF-E-3001) IS FACING NORTH ON ONE 20 POLE.

NOTES:
1. SEE ELECTRICAL SITE PLAN SHEET 1 FOR ALL TYPICAL CALL OUTS AND NOTES AND RE UIREMENTS.

0 30 60
SCALE IN FEET

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

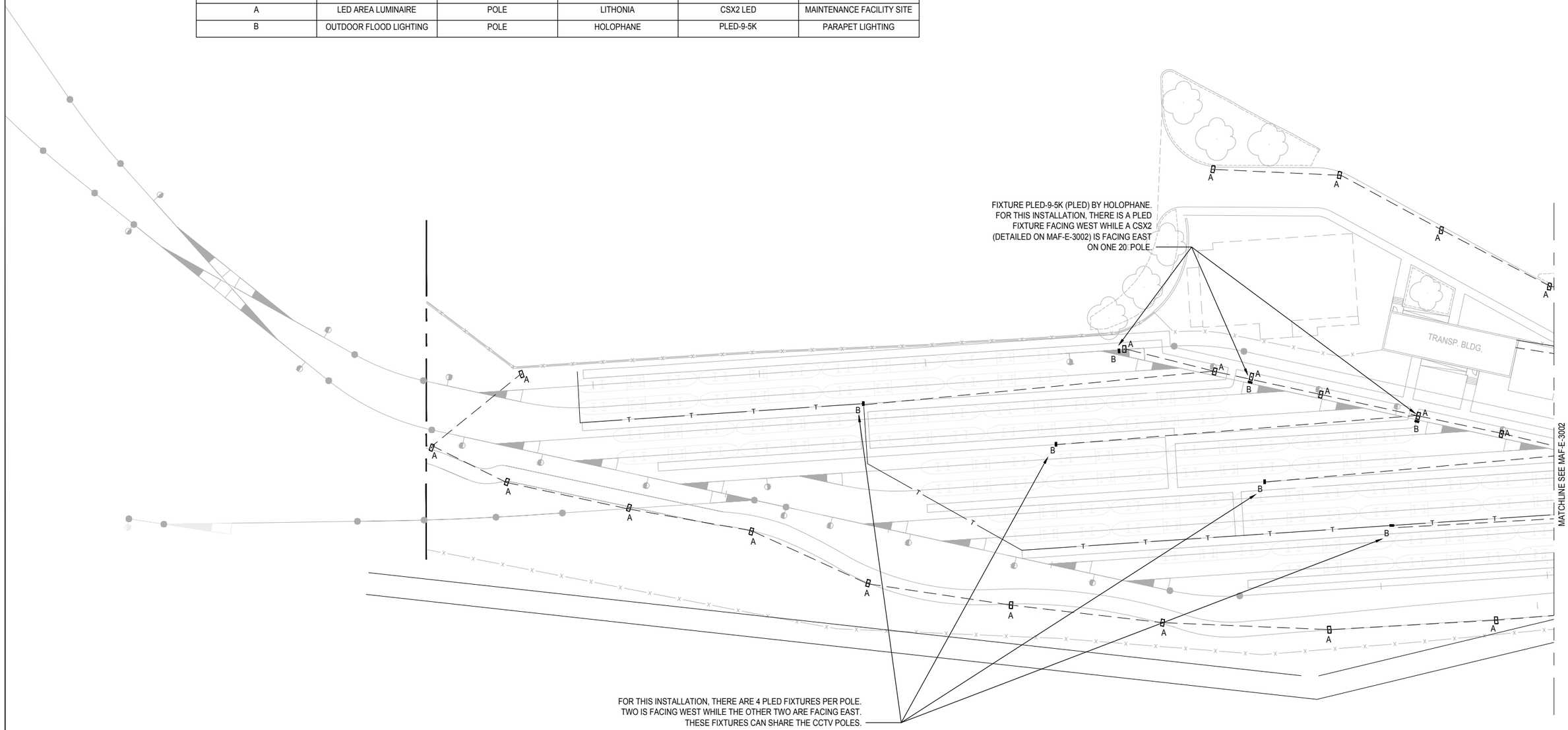
MAINTENANCE FACILITY ELECTRICAL SITE PLAN SHEET 2

DATE: SEPT. 28, 2017 | SCALE: 1":30 | SHEET **MAF-E-2002**

N

NOTES:
1. SEE COMMENTS ON ELECTRICAL SITE PLAN SHEET 1

TAG	DESCRIPTION	MOUNTING	MANUFACTURERS	MODEL	LOCATION/REMARKS
A	LED AREA LUMINAIRE	POLE	LITHONIA	CSX2 LED	MAINTENANCE FACILITY SITE
B	OUTDOOR FLOOD LIGHTING	POLE	HOLOPHANE	PLED-9-5K	PARAPET LIGHTING


FIXTURE PLED-9-5K (PLED) BY HOLOPHANE. FOR THIS INSTALLATION, THERE IS A PLED FIXTURE FACING WEST WHILE A CSX2 (DETAILED ON MAF-E-3002) IS FACING EAST ON ONE 20' POLE.
TRANSP. BLDG.
MATCHLINE SEE MAF-E-3002
FOR THIS INSTALLATION, THERE ARE 4 PLED FIXTURES PER POLE. TWO IS FACING WEST WHILE THE OTHER TWO ARE FACING EAST. THESE FIXTURES CAN SHARE THE CCTV POLES.

0 30 60
SCALE IN FEET

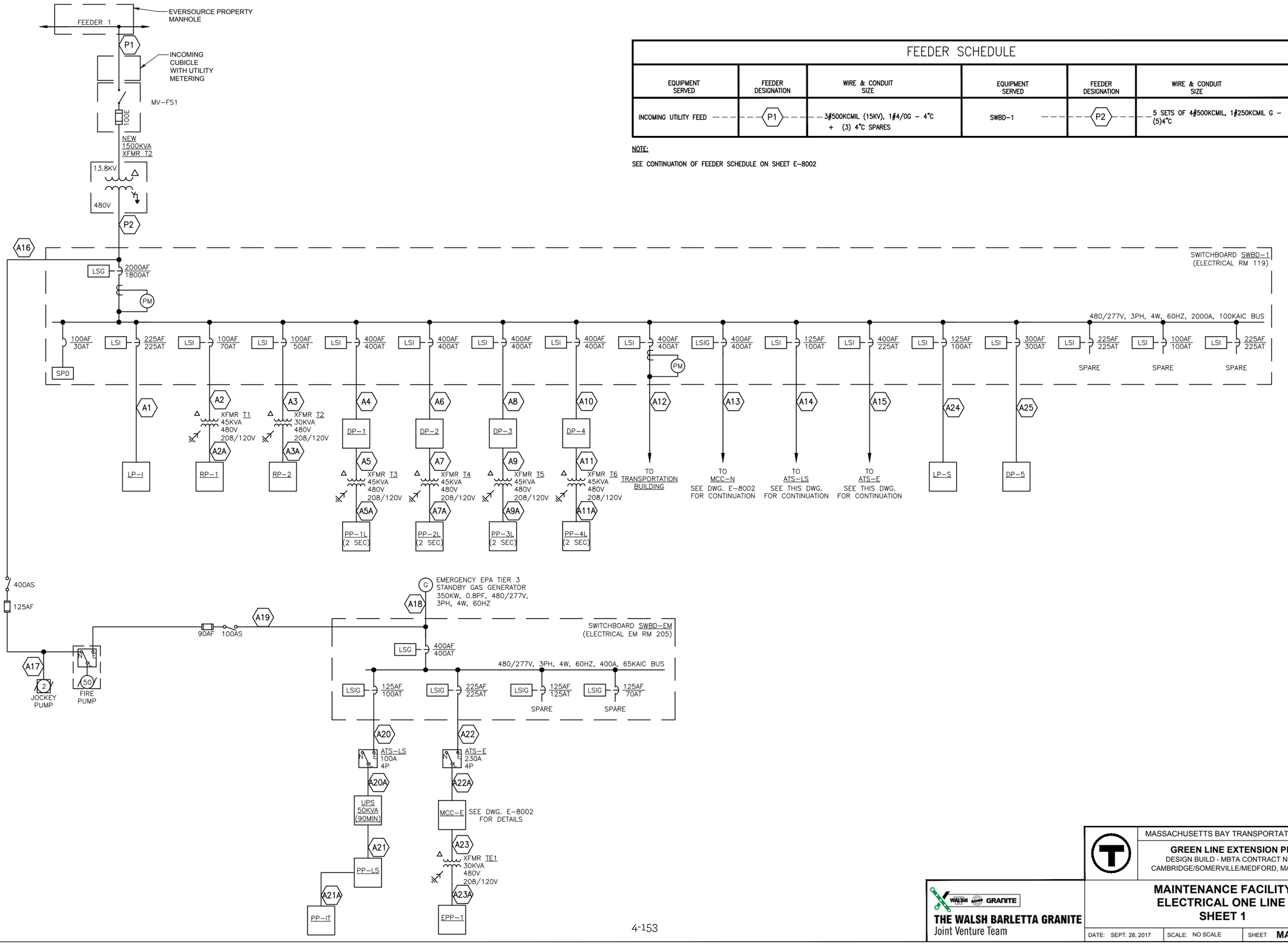
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY
ELECTRICAL SITE PLAN
SHEET 3

DATE: SEPT. 28, 2017 | SCALE: 1" :30□ | SHEET **MAF-E-2003**



FEEDER SCHEDULE

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE	EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
INCOMING UTILITY FEED	P1	3#500KCMIL (15KV), 1#4/0G - 4"C + (3) 4"C SPARES	SWBD-1	P2	5 SETS OF 4#500KCMIL, 1#250KCMIL G - (5)4"C

NOTE:

SEE CONTINUATION OF FEEDER SCHEDULE ON SHEET E-8002

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

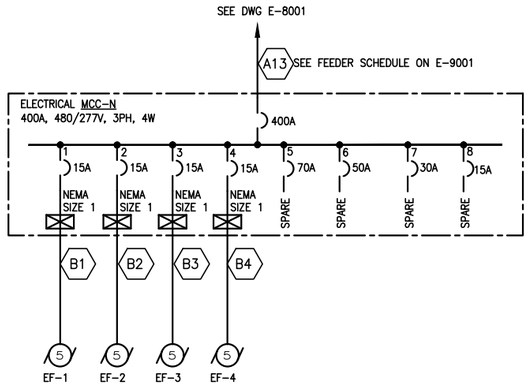
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

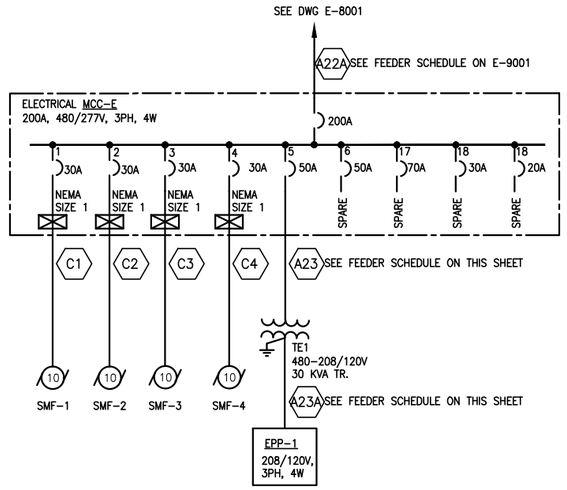
WALSH GRANITE

THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY ELECTRICAL ONE LINE SHEET 1

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **MAF-E-9001**





ELECTRICAL ONE LINE DIAGRAM

NOT TO SCALE

FEEDER SCHEDULE

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
LP-I	A1	4#4/0, 1#4G – 2 1/2"C
XFMR T1	A2	3#4, 1#8G – 1"C
RP-1	A2A	4#1/0, 1#6G – 2"C
XFMR T2	A3	3#6, 1#10G – 1"C
RP-2	A3A	4#2, 1#8G – 1 1/4"C
DP-1	A4	4#600KCMIL, 1#3G – 4"C
XFMR T3	A5	3#4, 1#8G – 1"C
PP-1L	A5A	4#1/0, 1#6G – 2"C
DP-2	A6	4#600KCMIL, 1#3G – 4"C
XFMR T4	A7	3#4, 1#8G – 1"C
PP-2L	A7A	4#1/0, 1#6G – 2"C
DP-3	A8	4#600KCMIL, 1#3G – 4"C
XFMR T5	A9	3#4, 1#8G – 1"C
PP-3L	A9A	4#1/0, 1#6G – 2"C
DP-4	A10	4#600KCMIL, 1#3G – 4"C
XFMR T6	A11	3#4, 1#8G – 1"C
PP-4L	A11A	4#1/0, 1#6G – 2"C

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
TRANSPORTATION BUILDING	A12	8#600KCMIL, 2#3G – (2)4"C
MCC-N	A13	4#600KCMIL, 1#4G – 4"C
ATS-LS (N)	A14	4#1, 1#6G – 2"C (IN 2HR CONST.)
ATS-E (N)	A15	4#250KCMIL, 1#4G – 2 1/2"C (IN 2HR CONST.)
FIRE PUMP (N)	A16	4#2, 1#8G – 1 1/4"C (IN 2HR CONST.)
JOCKEY PUMP	A17	3#10, 1#12G – 1"C
SWBD-EM	A18	8#300KCMIL, 1#1G – (2)3"C (IN 2HR CONST.)
FIRE PUMP (EM)	A19	4#2, 1#8G – 1 1/4"C (IN 2HR CONST.)
ATS-LS (E)	A20	4#2, 1#6G – 2"C (IN 2HR CONST.)
UPS	A20A	3#2, 1#6G – 2"C (IN 2HR CONST.)
PP-LS	A21	3#250KCMIL, 1#600KCMIL N, 1#8G – 3"C
PP-IT	A21A	4#6, 1#10G – 1 1/4"C
ATS-E (E)	A22	4#4/0, 1#4G – 2 1/2"C (IN 2HR CONST.)
MCC-E	A22A	4#4/0, 1#4G – 2 1/2"C
XFMR TE1	A23	3#6, 1#10G – 1"C
EPP-1	A23A	4#2, 1#8G – 1 1/4"C
LP-S	A24	4#2, 1#8G – 1 1/4"C
DP-5	A25	4#350, 1#4G – 3"C

FEEDER SCHEDULE FOR MCC-E

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
SMF-1	C1	3#8, 1#10G – 1 1/4"C
SMF-2	C2	3#8, 1#10G – 1 1/4"C
SMF-3	C3	3#8, 1#10G – 1 1/4"C

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
SMF-4	C11	3#8, 1#10G – 1 1/4"C

FEEDER SCHEDULE FOR MCC-N

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
EF-1	B1	3#10, 1#10G – 1"C
EF-2	B2	3#10, 1#10G – 1"C
EF-3	B3	3#10, 1#10G – 1"C

EQUIPMENT SERVED	FEEDER DESIGNATION	WIRE & CONDUIT SIZE
EF-4	B11	3#10, 1#10G – 1"C

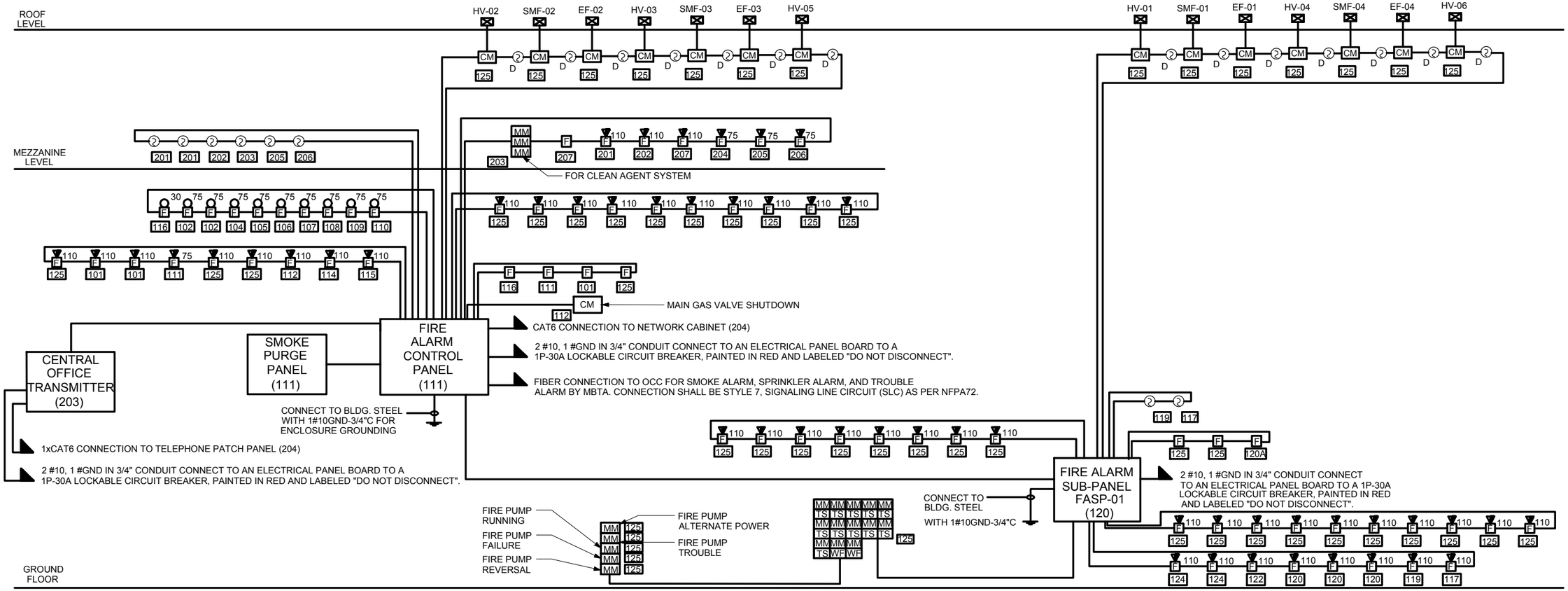
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY
ELECTRICAL ONE LINE
SHEET 2

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **MAF-E-9002**


ROOF LEVEL
MEZZANINE LEVEL
GROUND FLOOR
HV-02
SMF-02
EF-02
HV-03
SMF-03
EF-03
HV-05
HV-01
SMF-01
EF-01
HV-04
SMF-04
EF-04
HV-06
FOR CLEAN AGENT SYSTEM
MAIN GAS VALVE SHUTDOWN
CENTRAL OFFICE TRANSMITTER (203)
SMOKE PURGE PANEL (111)
FIRE ALARM CONTROL PANEL (111)
FIRE ALARM SUB-PANEL FASP-01 (120)
CONNECT TO BLDG. STEEL WITH 1#10GND-3/4"C FOR ENCLOSURE GROUNDING
CAT6 CONNECTION TO NETWORK CABINET (204)
2 #10, 1 #GND IN 3/4" CONDUIT CONNECT TO AN ELECTRICAL PANEL BOARD TO A 1P-30A LOCKABLE CIRCUIT BREAKER, PAINTED IN RED AND LABELED "DO NOT DISCONNECT".
FIBER CONNECTION TO OCC FOR SMOKE ALARM, SPRINKLER ALARM, AND TROUBLE ALARM BY MBTA. CONNECTION SHALL BE STYLE 7, SIGNALING LINE CIRCUIT (SLC) AS PER NFPA72.
1xCAT6 CONNECTION TO TELEPHONE PATCH PANEL (204)
2 #10, 1 #GND IN 3/4" CONDUIT CONNECT TO AN ELECTRICAL PANEL BOARD TO A 1P-30A LOCKABLE CIRCUIT BREAKER, PAINTED IN RED AND LABELED "DO NOT DISCONNECT".
2 #10, 1 #GND IN 3/4" CONDUIT CONNECT TO AN ELECTRICAL PANEL BOARD TO A 1P-30A LOCKABLE CIRCUIT BREAKER, PAINTED IN RED AND LABELED "DO NOT DISCONNECT".
CONNECT TO BLDG. STEEL WITH 1#10GND-3/4"C
FIRE PUMP RUNNING
FIRE PUMP FAILURE
FIRE PUMP REVERSAL
FIRE PUMP ALTERNATE POWER
FIRE PUMP TROUBLE

FIRE ALARM RISER DIAGRAM

NO SCALE

XXX ROOM DESIGNATION

GENERAL NOTES

1. PROVIDE CLASS "A" NOTIFICATION APPLIANCE CIRCUITS.
2. PROVIDE CLASS "A" INITIATING DEVICE CIRCUITS.
3. INSTALL NOTIFICATION APPLIANCE CIRCUIT WIRING CONTINUOUS FROM NOTIFICATION APPLIANCE TO NOTIFICATION APPLIANCE WITHOUT SPLICES.
4. INSTALL INITIATING DEVICE CIRCUIT WIRING CONTINUOUS FROM INITIATING DEVICE TO INITIATING DEVICE WITHOUT TAPS AND SPLICES.
5. USE MINIMUM #14AWG, 2 CONDUCTOR CABLE FOR NOTIFICATION APPLIANCE CIRCUIT WIRING.
6. USE MINIMUM #18AWG, 2 CONDUCTOR CABLE FOR INITIATING DEVICE CIRCUIT WIRING.
7. PROVIDE CONNECTION TO BUILDING MANAGEMENT SYSTEM CONTROL PANEL FOR FAN SHUTDOWN.
8. PROVIDE CONNECTION TO SCADA FOR SUPERVISORY ALARMS
9. STARTERS FOR EXHAUST FANS SHALL BE PROVIDED BY THE ELECTRICAL CONTRACTOR. SEE PLAN DRAWINGS FOR LOCATIONS.
10. STARTERS FOR HEATING VENTILATING UNITS SHALL BE PROVIDED BY THE MECHANICAL CONTRACTOR.
11. CONTRACTOR TO PROVIDE BACKUP BATTERY CALCULATIONS FOR FIRE ALARM CONTROL PANEL AND SUB-PANELS.
12. FIRE ALARM SHALL SHUTDOWN THE TWO MAIN GAS VALVES UPON FIRE ALARM CONDITION.
13. PROVIDE INTERFACE FOR FIRE SMOKE DAMPERS PROVIDED BY MECHANICAL CONTRACTOR

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
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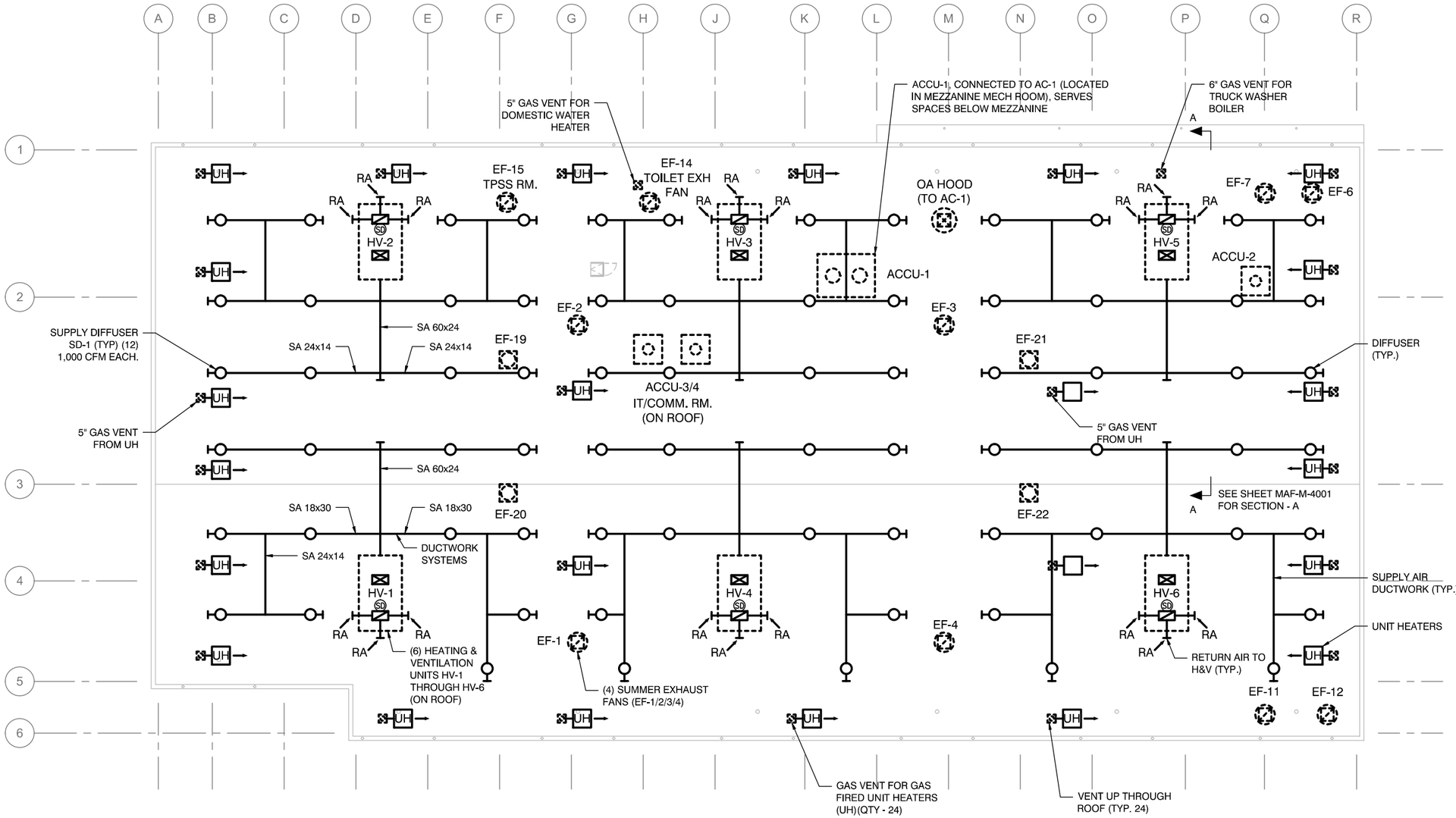
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MAINTENANCE FACILITY
FIRE ALARM RISER DIAGRAM

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **MAF-F-9001**



1 HVAC UPPER LEVEL AND ROOF PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

GENERAL NOTES:

1. ALL HVAC EQUIPMENT ON ROOF ARE DOTTED.

ABBREVIATIONS:

EF	EXHAUST FAN
HV	HEATING & VENTILATING UNIT W/ HEAT RECOVERY
RA	RETURN AIR
SA	SUPPLY AIR
SD	SMOKE DETECTOR
UH	GAS-FIRED UNIT HEATER

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MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY
PROPOSED HVAC UPPER LEVEL AND ROOF PLAN

DATE: SEPT. 28, 2017 | SCALE: 1/16" = 1'-0" | SHEET MAF-M-2102

Greenline Extension Project, GLX
HVAC 20% Design
HVAC Equipment 6/1/2017

Tag No.	Equipment	Area Served	Capacity Data	Supply Air CFM	Electrical Data Voltage	Notes
HV-1 to HV-6	Heating & Ventilating Unit Natural Gas	Maintenance Shop, Loc Roof No Air Cond	100% Outside Air	12,000	460V 3 PH	
AC-1	Air Conditioning Unit	1st Floor Spaces Loc'n- Mezz		3,000	460-3 PH	
ACCU-1	AC-1	Roof	10 Tons Cooling		"	
AC-2	Air Cond Unit Split, Heat Pump	Shop Foreman Office	3/4 Ton Cooling	400	2120v-1 PH	
ACCU-2	AC-2	Roof	3/4 Ton Cooling			
AC-3/4	Air Cond Unit Split, Heat Pump	Communication RM, AC in Room	2 units in Communic ation Rm	Two(2) 1-1/2 Ton Cooling Unuts	208V 1PH	
ACCU-3	Cond Unit	AC-3		Two(2) units	208V-1PH	
ACCU-4	Roof	AC-4			208V-1PH	
G-UH	Unit Heaters, Gas, Forced Air 20 Perim, 4 Inter	Maint Shop	(QTY:24)		480V-3PH	
G-AC	Air Curtain N Gas 12' & 16' Doors	Maint Shop Cols 1-2/ R	QTY:1		460-V 3PH 15 HP	
EUH-1	Wall-MTD Electric Unit Heater	Toilet Rm-Women's	1500 Watts		120V 1PH	
EUH-2	Wall- Mtd Electric Unit Heater	Toilet RM- Men's	1500 Watts		120V-	
EUH-3	Suspended Electric Unit Heater	Mech Rm-Mezz	2-KW		460V-3PH	
EUH-4	Suspended Electric Unit Heater	Traction Room	2-KW		460V-3PH	
EUH-5/6	Suspended Electric Unit Heater	Storage RMs 120, 124	5 KW		460V-3PH	
EUH-7/8/9	Suspended Electric Unit Heater	Clean RM 122, F Pump RM119, Elect RM 117	2 KW		460V-3PH	

Greenline Extension Project, GLX
HVAC 20 % Design R Haas 6/1/2017

Tag No.	Area Serves	Location	Fan Type	Exhaust CFM	Motor HP	Electrical Data Voltage	Notes
EF-1 to 4	Maint Shop Rm 125 (Qty:4)	Roof	D Blast	15,000	5 HP	460V-3-PH	
EF-5	Compressor Room 114 Vent	Roof	D-blast	2,000	1 HP	460 V-3PH	
EF-6	Lube Room 115 Vent 1 CFM/SF	Roof	D blast	300	1/4 HP	120v-1 PH	
EF-7	Truck wash Vent Hood Rm 113	Roof	Upblast	2,000	2 HP	460V-3 PH	
EF-8	Stor Rm 124	Roof	D blast	500	1/2 HP	120V-1 PH	
EF-9	Stor Rm 124	Roof	D blast	800	1/2 HP	120V-1PH	
EF-9	Cleaning Rm 122	Roof	D blast				
EF-10	Stor Rm 120	Roof	D blast	500	1/2 HP	120V-1PH	
EF-11	Elect Rm 119	Roof	D blast	700	1/2 HP	120V-1PH	
EF-12	Fire Pump Rm 117	Roof	D blast	200	1/2 HP	120V-1PH	
EF-13	Mech Rm 202	Roof	D blast	500	1/2 HP	460V	
EF-14	Toilet Rms 104/105	Roof	D blast	450	1/2 HP	120V-1 PH	
EF-15	TPSS Rm 201	Roof	D blast	2400	1 HP	460 V	
EF-16	Elect Rm 205	Roof	D blast	300	1/2 HP	120V	
EF-17	IT/Communic ation Rm 204 FM200 Purge fan	Roof	Up blast	300	1/2 HP	120V 1PH	
EF-18	UPS Room	Roof	Up blast	500	1/2 HP	120V	
EF-19-22	Maintenance Shop (Qty:4)	Roof	D blast	15,000	5 HP	460V-3 PH	

1 PROPOSED MECHANICAL SCHEDULES

SCALE: N.T.S.

N

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

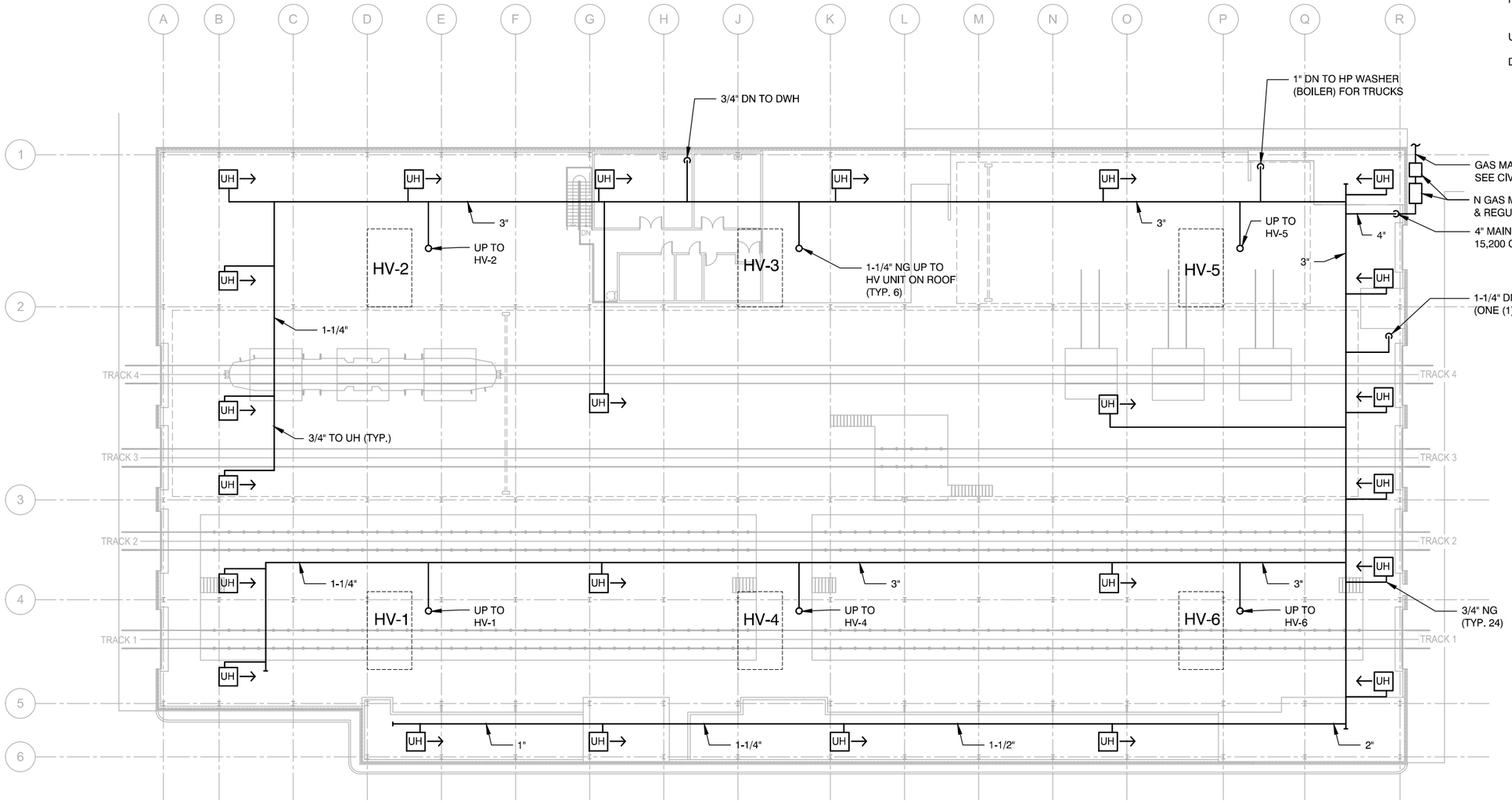
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILTY
PROPOSED MECHANICAL SCHEDULES

DATE: SEPT. 28, 2017 | SCALE: NONE | SHEET **MAF-M-9001**

ABBREVIATIONS

HV	HEATING AND VENTILATING UNIT WITH HEAT RECOVERY AND GAS HEATER
UH	UNIT HEATERS (GAS FIRED)
DWH	DOMESTIC WATER HEATER



1 MEZZANINE LEVEL PLUMBING PLAN - NATURAL GAS PIPING PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

N

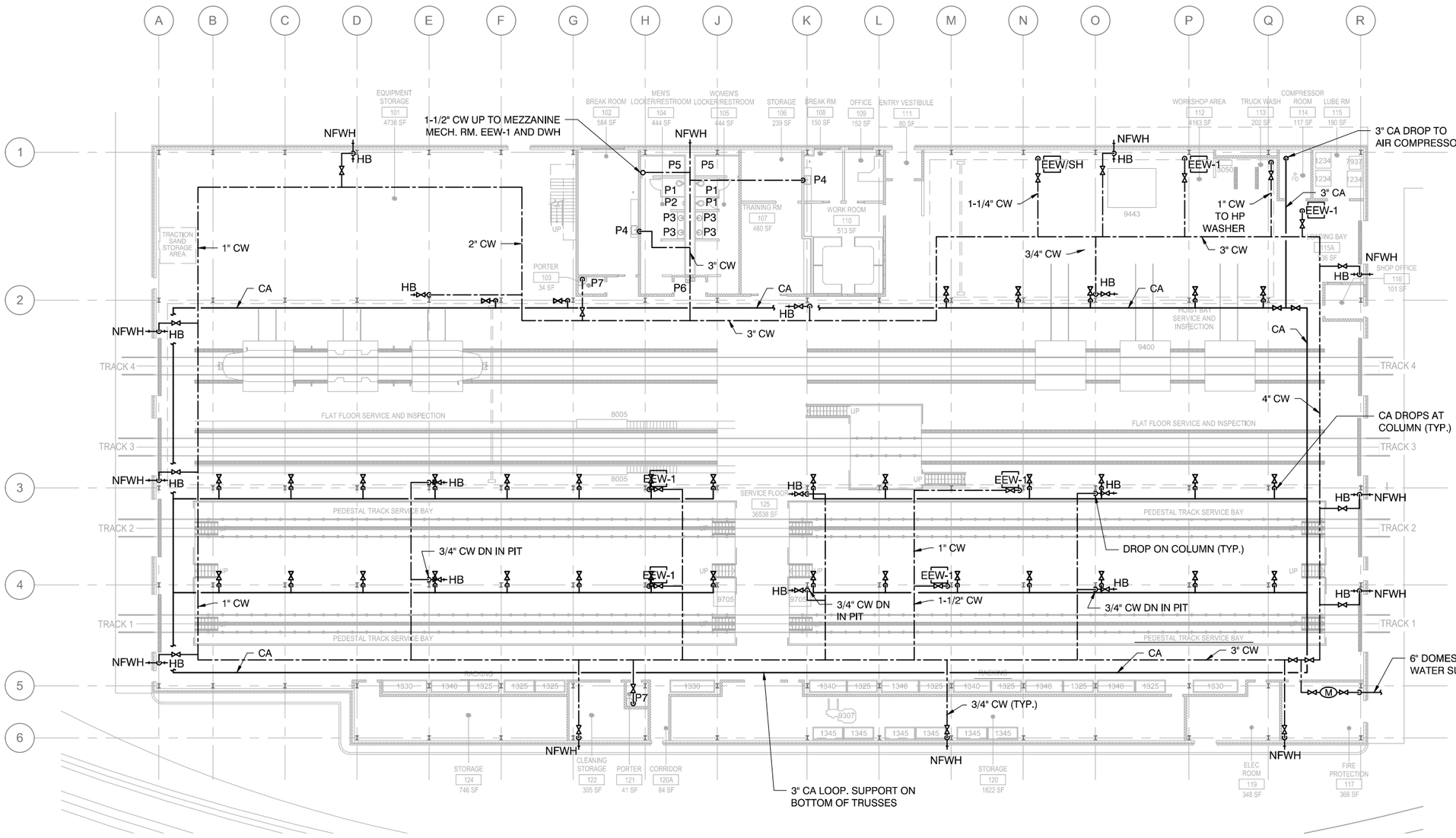
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY
MEZZANINE LEVEL PLUMBING PLAN
PROPOSED NATURAL GAS PIPING PLAN

DATE: SEPT. 28, 2017 | SCALE: 1/16"=1'-0" | SHEET **MAF-P-2101**

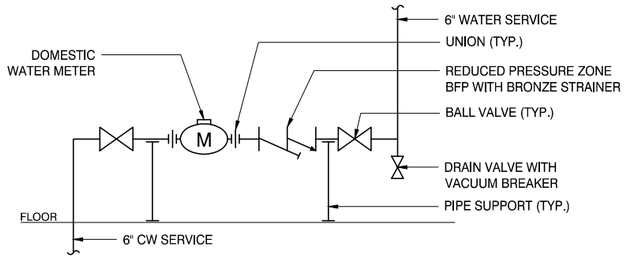


ABBREVIATIONS:

CA	COMPRESSED AIR
CW	DOMESTIC COLD WATER
DWH	DOMESTIC WATER HEATER
EEW	EMERGENCY EYE WASH
EEW/SH	EMERGENCY EYE WASH & SHOWER
HB	HOSE BIBB
NFWH	NON FREEZE WALL HYRANT
P1	WATER CLOSET
P2	URINAL
P3	LAVATORY SINK
P4	KITCHEN SINK
P5	SHOWER
P6	ELECTRIC WATER COOLER
P7	MOP SINK

1 DOMESTIC WATER AND COMPRESSED AIR PIPING PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'



2 DOMESTIC WATER SERVICE DETAIL

SCALE: N.T.S.

N

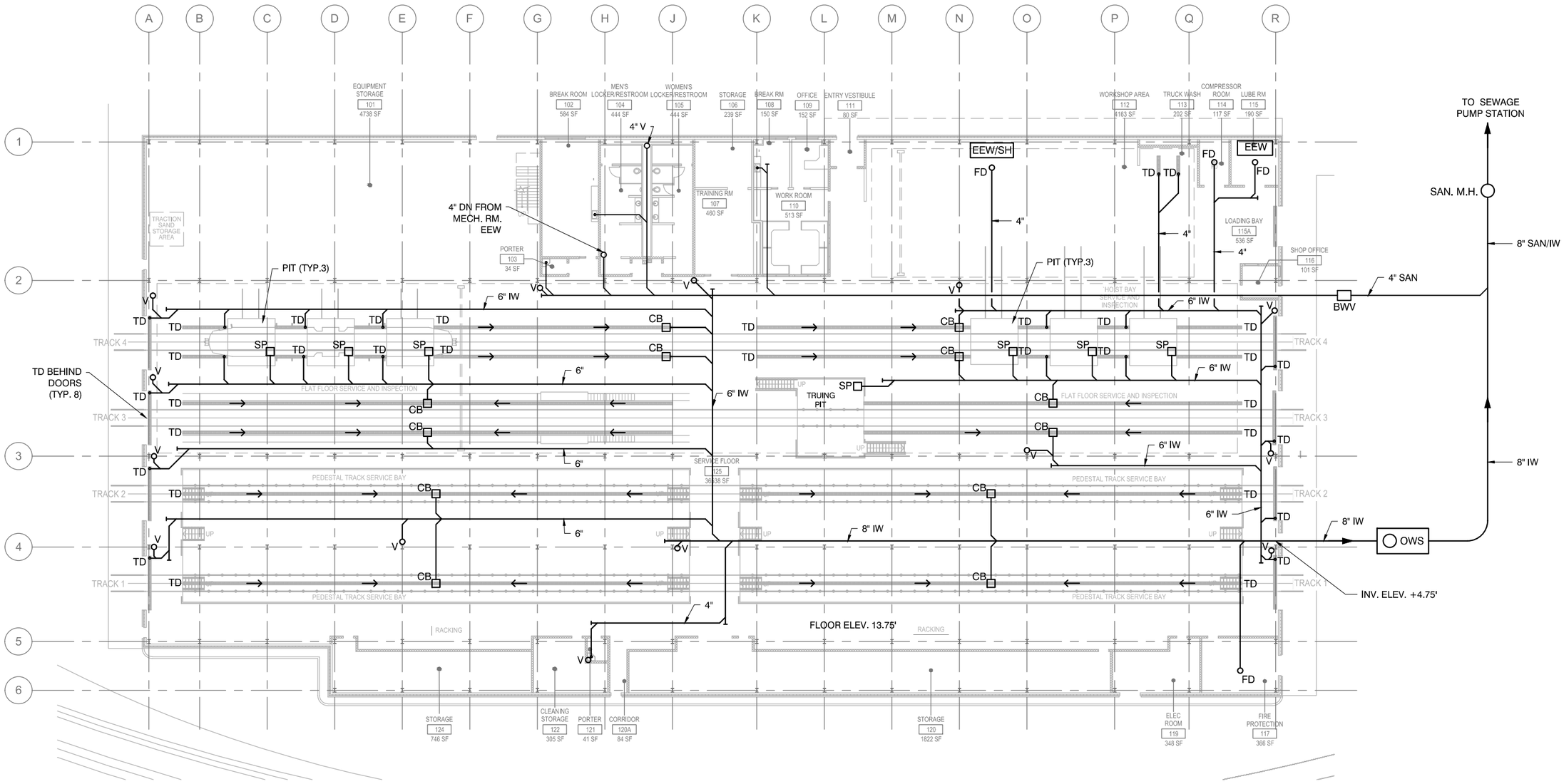
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MAINTENANCE FACILITY
PROPOSED DOMESTIC WATER AND COMPRESSED AIR SYSTEMS PLAN

DATE: SEPT. 28, 2017 | SCALE: 1/16" = 1'-0" | SHEET **MAF-P-2201**



1 PROPOSED SANITARY AND INDUSTRIAL WASTE PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

ABBREVIATIONS:

CB	CATCH BASIN (PART OF TD)
C.O	CLEAN OUT
EEW/SH	COMBINATION EMERGENCY EYEWASH/SHOWER
FD	FLOOR DRAIN (W/ TRAP PRIMERS
INV	PIPE INVERT ELEVATION
IW	INDUSTRIAL WASTE (SHOP WASTE, ALL LIQUID WASTES)
MH	MANHOLE, SAN
OWS	OIL WATER SEPARATOR (IW ONLY)
SAN	SANITARY WASTE, (LIQUIDS AND SOLIDS)
SP	SUMP PUMP (SUMPS BELOW IN PITS)
TD	TRENCH DRAIN, LINEAR TYPE
V	VENT PIPE UP TO ROOF
VTR	VENT THROUGH THE ROOF

SUMP PUMPS

SP-1 THRU SP-7
EACH RATED AT 10 GPM, 20 FT, TDH
1/3 HP MOTOR 120V - 1PH POWER

N

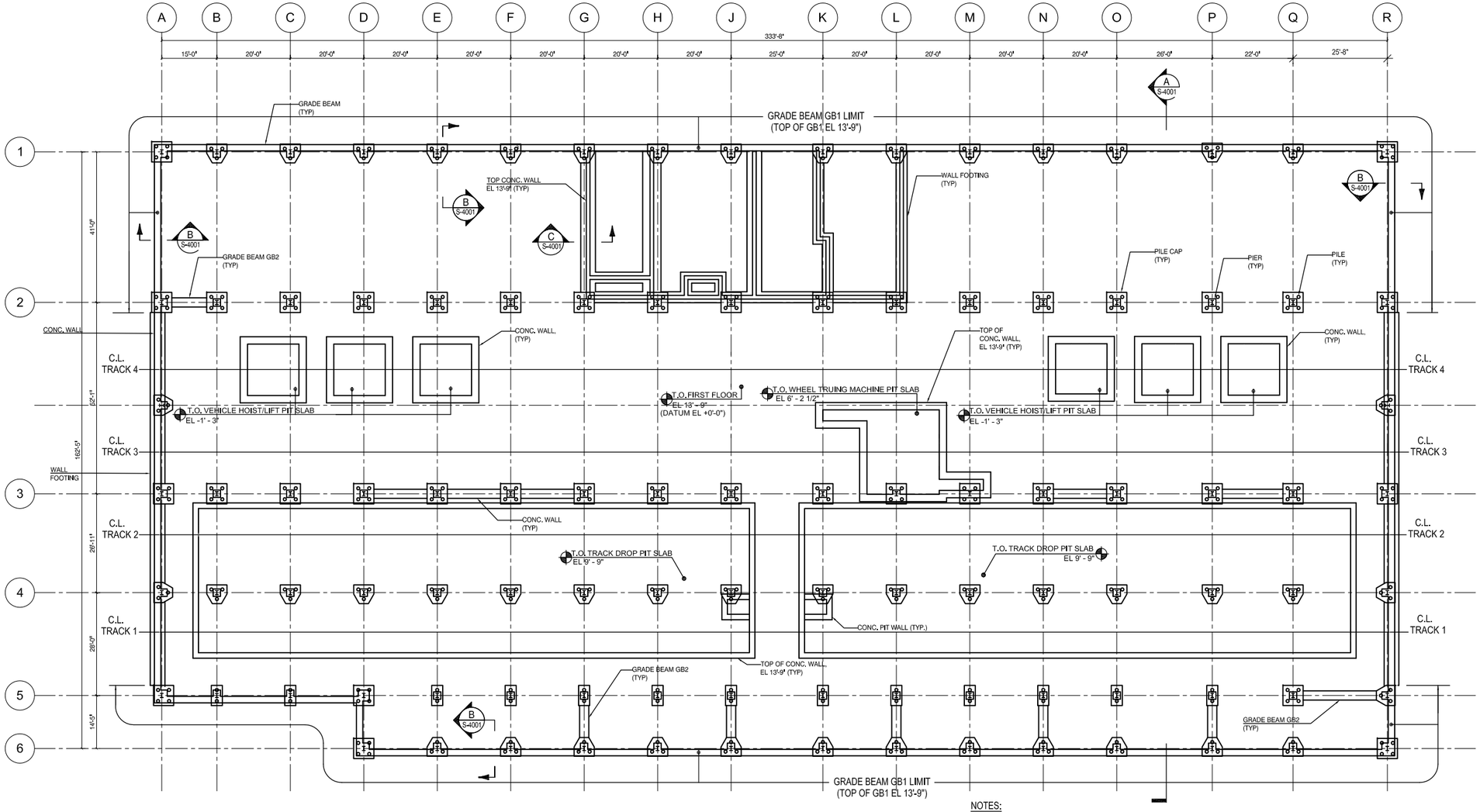
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MAINTENANCE FACILITY
PROPOSED SANITARY AND WASTE PLAM

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: 1/16" = 1'-0" | SHEET **MAF-P-2301**


A B C D E F G H J K L M N O P Q R
333'-8"
15'-0" 20'-0" 20'-0" 20'-0" 20'-0" 20'-0" 20'-0" 20'-0" 25'-0" 20'-0" 20'-0" 20'-0" 20'-0" 26'-0" 22'-0" 25'-8"
1 2 3 4 5 6
41'-0"
62'-1"
162'-5"
26'-11"
28'-0"
14'-5"
GRADE BEAM (TYP)
GRADE BEAM GB1 LIMIT
(TOP OF GB1 EL 13'-9")
A S-4001
B S-4001
C S-4001
TOP CONC. WALL EL 13'-9" (TYP)
WALL FOOTING (TYP)
GRADE BEAM GB2 (TYP)
PILE CAP (TYP)
PIER (TYP)
PILE (TYP)
CONC. WALL
CONC. WALL, (TYP)
TOP OF CONC. WALL, EL 13'-9" (TYP)
C.L. TRACK 4
C.L. TRACK 3
C.L. TRACK 2
C.L. TRACK 1
T.O. VEHICLE HOIST/LIFT PIT SLAB EL -1' - 3"
T.O. FIRST FLOOR EL 13' - 9" (DATUM EL +0'-0")
T.O. WHEEL TRUING MACHINE PIT SLAB EL 6' - 2 1/2"
WALL FOOTING
CONC. WALL (TYP)
T.O. TRACK DROP PIT SLAB EL 9' - 9"
CONC. PIT WALL (TYP.)
TOP OF CONC. WALL EL 13'-9" (TYP)
GRADE BEAM GB2 (TYP)
GRADE BEAM GB1 LIMIT
(TOP OF GB1 EL 13'-9")

1 FOUNDATION PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

NOTES:

1. THE WHEEL TRUING MACHINE PIT AND CAR HOIST/LIFT PITS SIZES SHALL BE FINALIZED AFTER FINALIZING THE EQUIPMENTS.
2. ALL STRUCTURE BELOW GROUND WATER TABLE SHALL RECEIVE WATERPROOFING SYSTEM.
3. NUMBER OF PILES AND SIZES OF PILE CAPS AND PIERS SHALL BE DESIGNED.

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MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

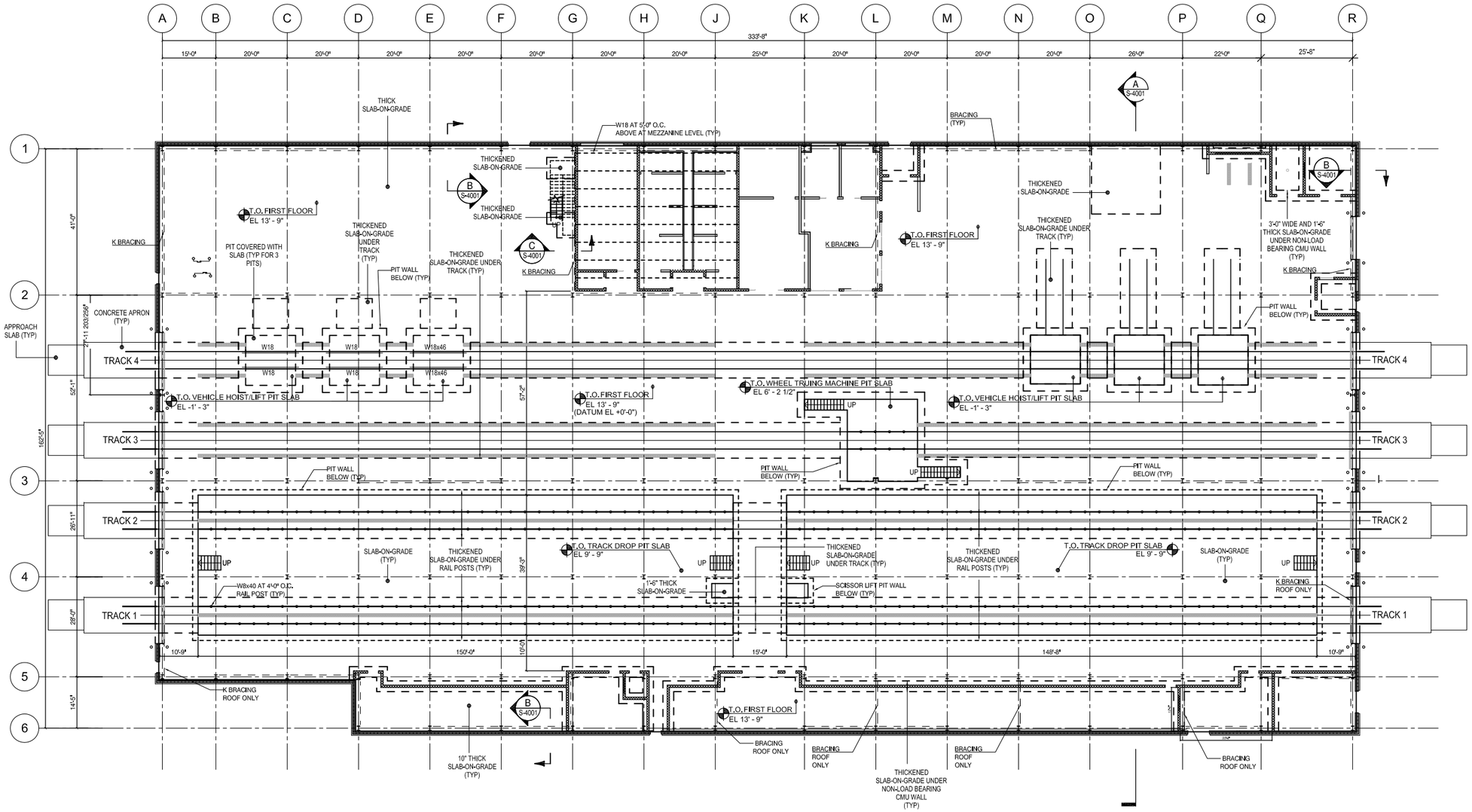
DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

FOUNDATION PLAN

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MAF S-2101



1 FIRST FLOOR SLAB PLAN

SCALE: 1/16" = 1'-0" 0 4' 8' 16' 32'

NOTES:

1. VAPOR BARRIER SHALL BE PROVIDED UNDER SLAB-ON-GRADE THAT DO NOT RECEIVE WATERPROOFING SYSTEM.
2. MINIMUM 6" THICK COMPACTED CRUSHED STONE SHALL BE PROVIDED UNDER SLAB-ON-GRADE U.N.O. ON THE DRAWINGS.
3. COMPACTED STRUCTURAL FILL SHALL BE PROVIDED UNDER CRUSHED STONE FOR SLAB-ON-GRADE PER GEOTECHNICAL RECOMMENDATION.
4. SUMP PITS SHALL BE PROVIDED COORDINATING WITH PLUMBING DRAWINGS.
5. THE MEZZANINE FLOOR SHALL BE CONCRETE OVER COMPOSITE METAL DECK (TOTAL THICKNESS OF SLAB INCLUDING METAL DECK IS 5.5 IN) .

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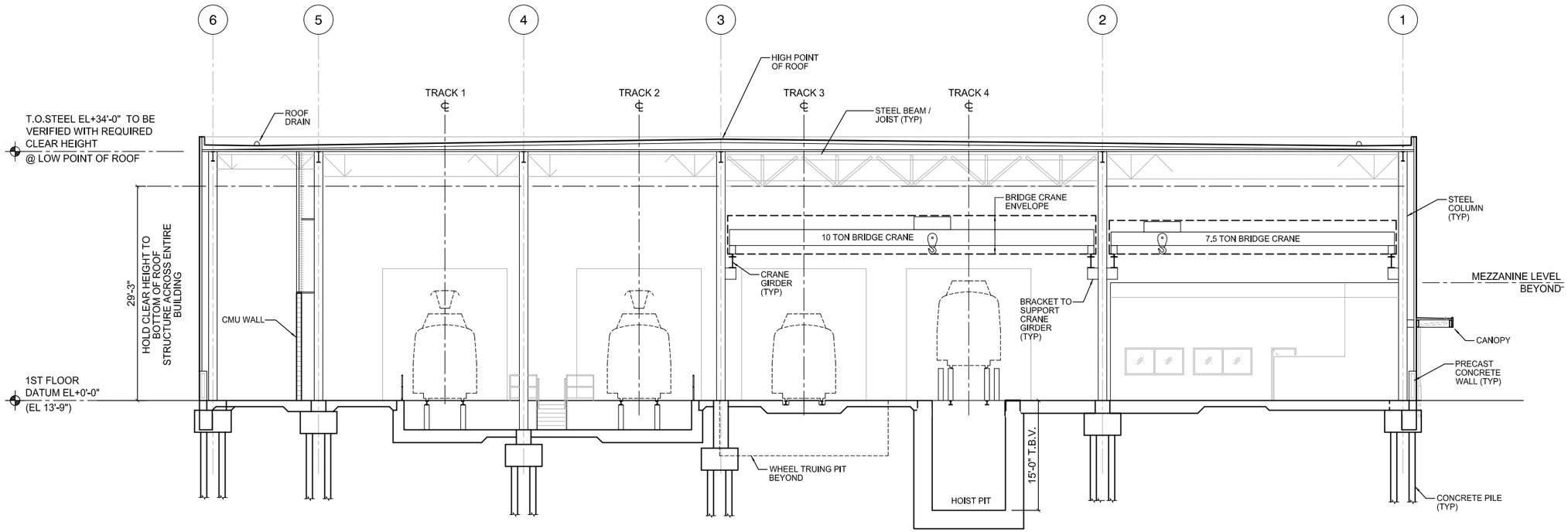
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

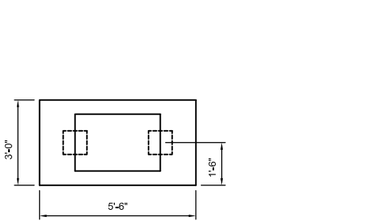
FIRST FLOOR SLAB PLAN

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MAF-S-2102



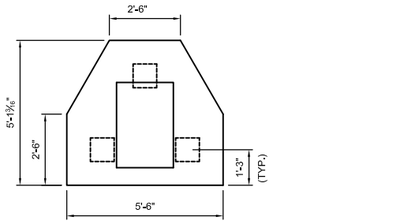
A S-2101 S-2102 **SECTION**

SCALE: 1/8" = 1'-0" 0 2' 4' 8' 16'



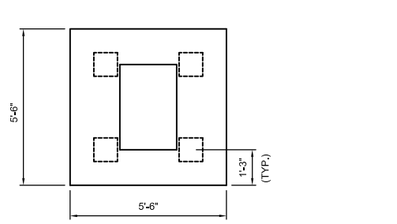
PILE CAP WITH 2 PILES AND PIER

0 3 6 SCALE IN FEET



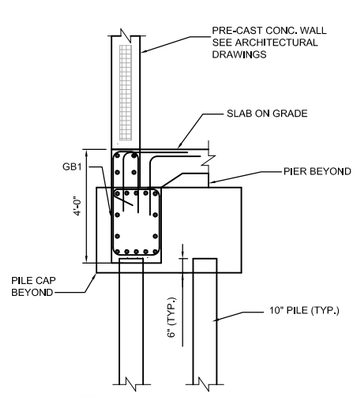
PILE CAP WITH 3 PILES AND PIER

0 3 6 SCALE IN FEET



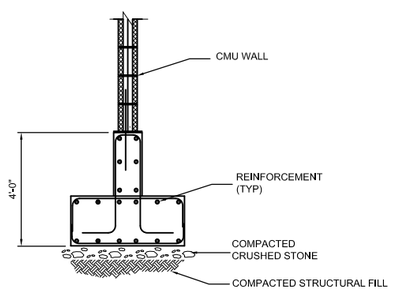
PILE CAP WITH 4 PILES

0 3 6 SCALE IN FEET



B S-2101 S-2102 **SECTION: TYPICAL GRADE BEAM GB1 REFIN.**

0 3 6 SCALE IN FEET



C S-2101 S-2102 **SECTION: WALL FOOTING**

0 3 6 SCALE IN FEET

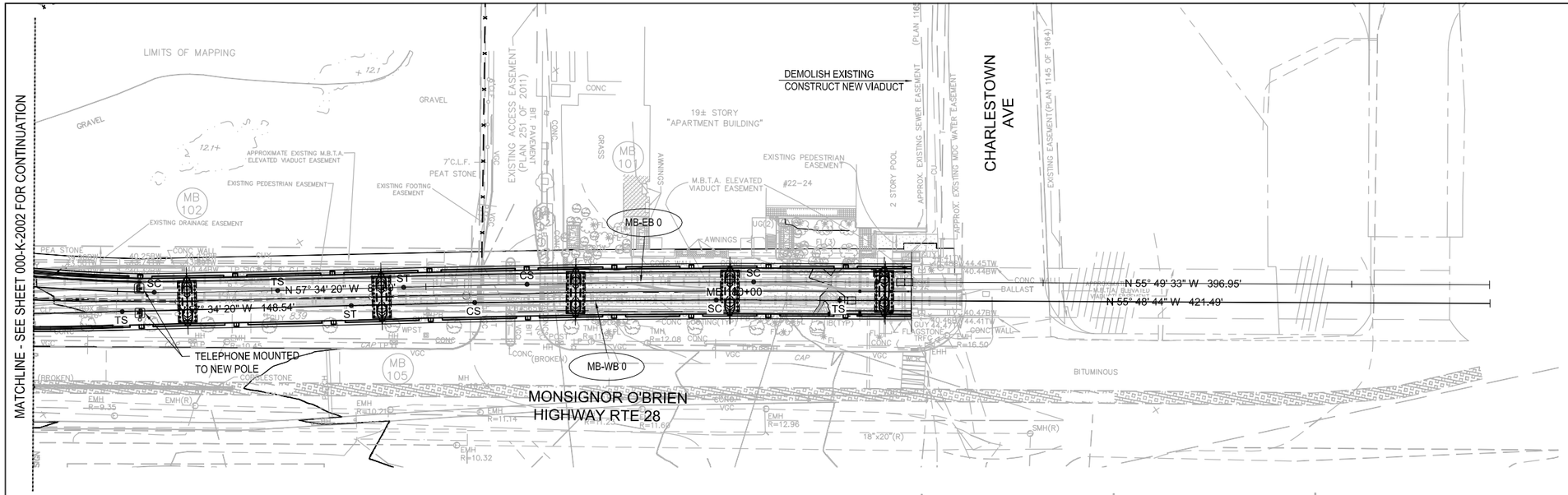
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

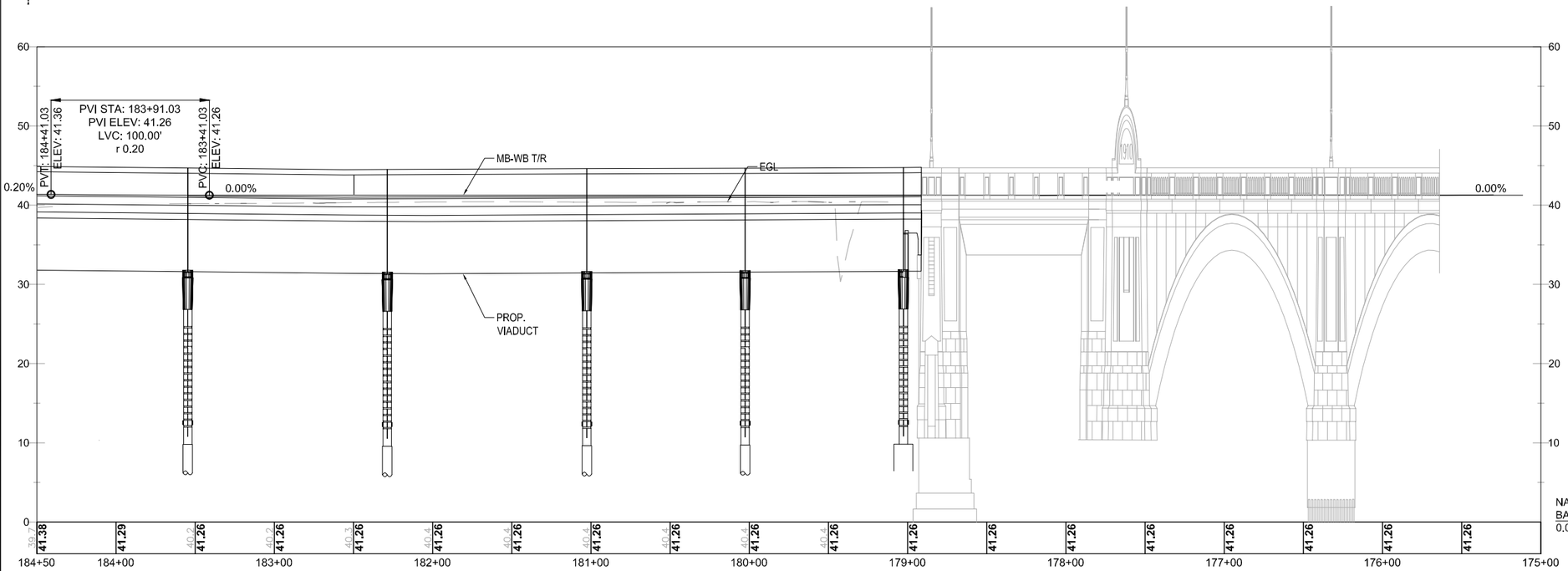
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

SECTIONS AND DETAILS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MAF-S-4001





CURVE MB-EB 0				CURVE MB-WB 0				CURVE MB-EB 1				CURVE MB-WB 1			
TS	179+07.56	Ls	80.00'	TS	179+33.07	Ls	80.00'	TS	182+96.15	Ls	80.00'	TS	183+98.18	Ls	80.00'
SC	179+87.56			SC	180+13.07			SC	183+76.15			SC	184+78.18		
SC	179+87.56	Lc	146.90'	SC	180+13.07	Lc	156.58'	SC	183+76.15	Lc	268.26'	SC	184+78.18	Lc	228.96'
		R	7443.94'			R	7701.29'			R	1100.00'			R	1100.00'
		Ea	0.25"			Ea	0.25"			Ea	2.00"			Ea	2.00"
		Eu	0.09"			Eu	0.09"			Eu	0.28"			Eu	0.28"
CS	181+34.46	V	25 MPH	CS	181+69.65	V	25 MPH	CS	186+44.41	V	25 MPH	CS	187+07.14	V	25 MPH
CS	181+34.46	Ls	80.00'	CS	181+69.65	Ls	80.00'	CS	186+44.41	Ls	80.00'	CS	187+07.14	Ls	80.00'
ST	182+14.46			ST	182+49.65			ST	187+24.41			ST	187+87.14		

PROFILE NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

GENERAL NOTES

1. ALL HORIZONTAL AND VERTICAL DISTANCES ARE IN FEET AND/OR DECIMALS OF A FOOT EXCEPT AS NOTED OTHERWISE.
2. COMMUTER RAIL CIRCULAR CURVES ARE DEFINED BY THE CHORD DEFINITION OF CURVATURE AND SPECIFIED BY DEGREE OF CURVATURE.
3. HORIZONTAL TRACK ALIGNMENT CONTROL POINTS, EXCEPT PIS, ARE LOCATED AT THE CENTERLINE OF THE PROPOSED TRACKS.
4. PROPOSED TRACK STATIONING IS MEASURED ALONG THE CENTERLINE OF THE PROPOSED TRACK ALIGNMENT. THE CONTROL TRACK IS THE RIGHT TRACK LOOKING IN THE DIRECTION OF INCREASING STATIONING. LIGHT RAIL AND COMMUTER RAIL ALIGNMENTS HAVE INDEPENDENT CONTROL TRACKS.
5. ALL GRADIENTS ARE IN PERCENT EXCEPT AS NOTED OTHERWISE.
6. THE TRACK PROFILE IS CARRIED ON THE TOP OF LOW RAIL THROUGH HORIZONTAL CURVES AND SPIRALS EXCEPT AS NOTED OTHERWISE.
7. SUPERELEVATION IS ACCOMPLISHED BY MAINTAINING THE LOW RAIL AT PROFILE GRADE AND RAISING THE OUTSIDE RAIL AN AMOUNT EQUAL TO THE SUPERELEVATION EXCEPT AS NOTED OTHERWISE.
8. ADJUST PROPOSED SIDING ALIGNMENTS AND PROFILES AS DIRECTED OR APPROVED BY THE ENGINEER TO MEET EXISTING TRACK.
9. THE LOCATION OF EXISTING FEATURES SUCH AS TRACKS, UNDERGROUND FACILITIES, POLES, STRUCTURES, AND UTILITIES ARE BASED ON AVAILABLE SURVEYS AND RECORDS AND MUST BE CONSIDERED APPROXIMATE. CONTRACTOR SHALL FIELD VERIFY THE LOCATIONS OF EXISTING FEATURES.
10. ALL ABOVE GRADE STRUCTURES, POLES, TRANSFORMERS, ETC. TO BE RELOCATED OR NEW SHALL BE PLACED AT A MINIMUM OFFSET EQUAL TO THE MBTA STANDARD CLEARANCE FROM THE CENTERLINE OF TRACK UNLESS OTHERWISE NOTED.
11. ALL WORK SHALL BE IN ACCORDANCE WITH THE GUILFORD RAIL SYSTEM TRACK MAINTENANCE AND CONSTRUCTION MANUAL, THE MBTA MW-1 SPECIFICATIONS FOR CONSTRUCTION AND MAINTENANCE OF TRACK AND THE MBTA RAILROAD OPERATIONS BOOK OF STANDARD PLANS DATED JANUARY 5, 1996 AND THE LATEST REVISIONS UNLESS OTHERWISE NOTED ON THE CONTRACT DRAWINGS OR SPECIFICATIONS.
12. ALL NEW TRACK CONSTRUCTION SHALL BE RESILIENTLY FASTENED., UNLESS OTHERWISE NOTED.
13. ALL EXISTING USGS DISKS, HIGHWAY BOUNDS, RAILROAD MONUMENTS, PROPERTY BOUNDS, AND TOWN BOUNDS SHALL BE PROTECTED AND RAISED TO FINISHED GRADE AS REQUIRED. USGS DISKS AND TOWN BOUNDS WILL BE ADJUSTED BY USGS AND MASSDOT RESPECTIVELY. ANY DAMAGE TO USGS DISKS SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER AND THE US GEOLOGICAL SURVEY AND SHALL BE REPAIRED AT NO COST TO THE AUTHORITY. ANY DAMAGE TO TOWN BOUNDS SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER AND MASSDOT AND SHALL BE REPAIRED AT NO COST TO THE AUTHORITY. THE CONTRACTOR SHALL INVENTORY ALL SUCH BOUNDS, DISKS, AND MONUMENTS PRIOR TO THE START OF ANY WORK.
14. WORK WINDOWS SHALL BE COORDINATED WITH PAN AM SOUTHERN RAILWAYS AND CSX TO ALLOW OPERATION ON ALTERED SCHEDULES.
15. EXISTING OPERATION OF THE MBTA NEW HAMPSHIRE SHALL BE MAINTAINED THROUGHOUT ALL STAGES OF CONSTRUCTION EXCEPT DURING SERVICE OUTAGES APPROVED BY THE MBTA.

SYMBOL	DESCRIPTION
℄	CENTERLINE
	POINT OF SWITCH
●	POINT OF CURVE/SPIRAL
Δ	POINT OF VERTICAL INTERSECTION
Ea	ACTUAL SUPERELEVATION
Ee	TOTAL SUPERELEVATION
Eu	UNBALANCED SUPERELEVATION
V	DESIGN SPEED IN MPH
TO	TURNOUT
XO	CROSSOVER
NH-T1 1	CURVE NUMBER
	PROFILE GRADE LINE
MP 1	MILE POST
SIH	SIGNAL INSTRUMENT HOUSE (COMMUTER RAIL)
CIH	CONTROL INSTRUMENT HOUSE (LIGHT RAIL)
EQ	TRACK ALIGNMENT STATION EQUATION
2E	SIGNAL
	BALLAST MAT
	HMA UNDERLAYMENT

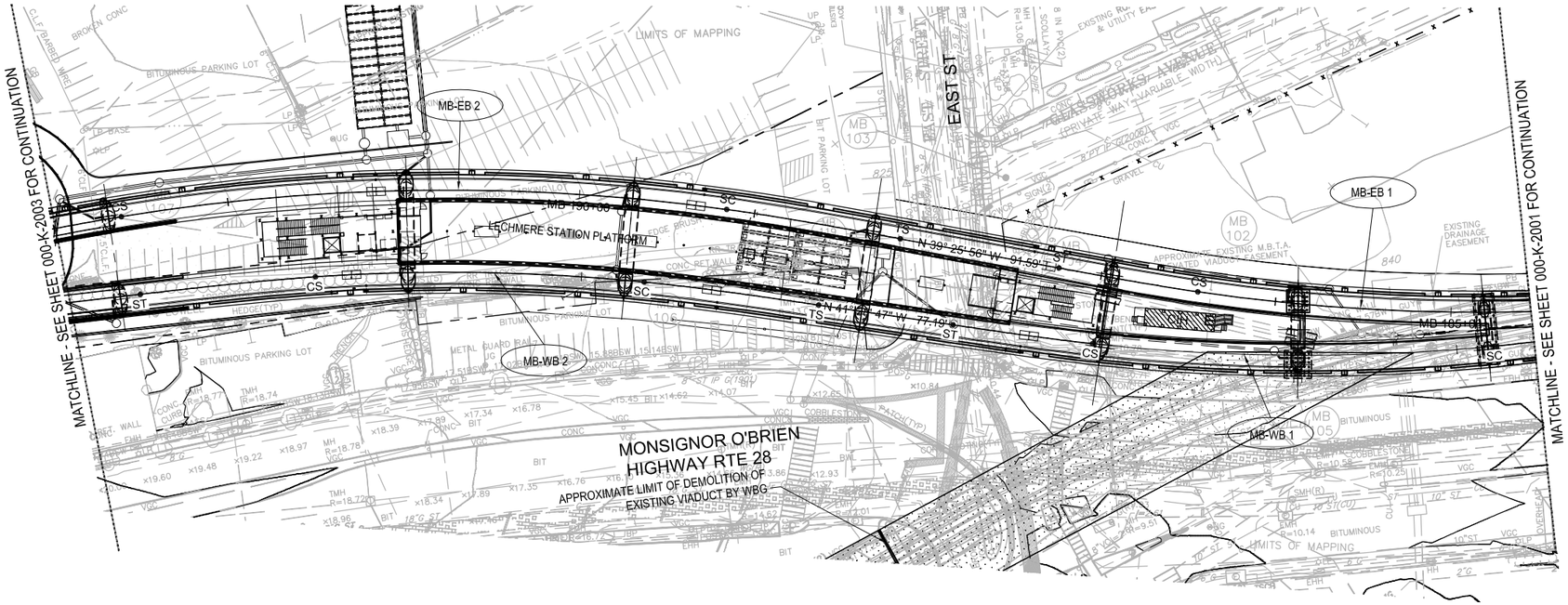
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

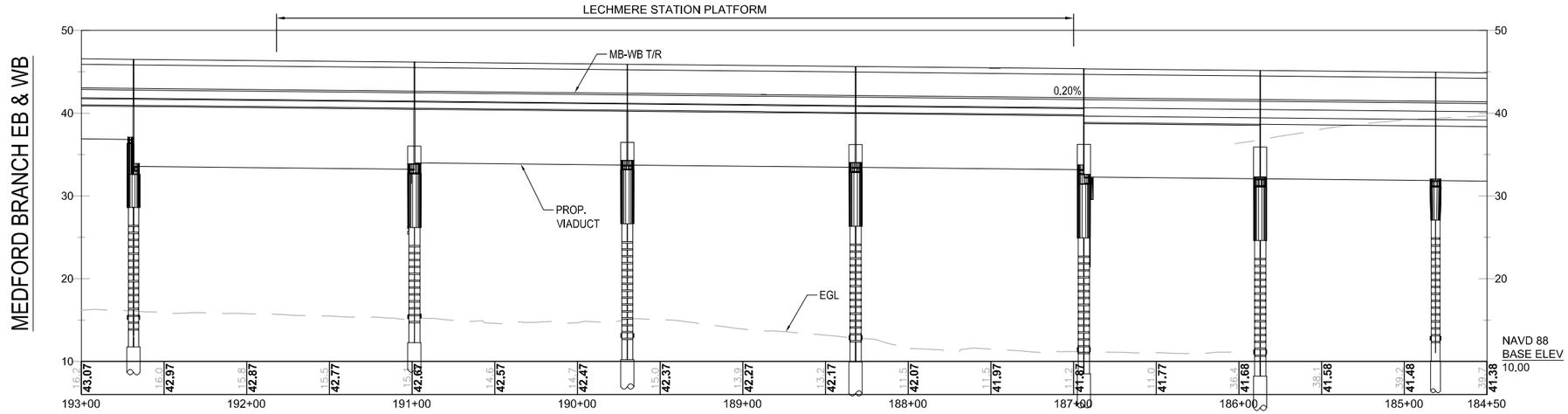
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 175+00 TO STA. MB-WB 184+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2001





CURVE MB-EB 2				CURVE MB-WB 2			
TS	188+16.00	Ls	100.00'	TS	188+64.33	Ls	100.00'
SC	189+16.00			SC	189+64.33		
SC	189+16.00	Lc	345.10'	SC	189+64.33	Lc	186.82'
		R	1147.50'			R	1100.00'
		Ea	1.00"			Ea	1.00"
		Eu	1.18"			Eu	1.28"
CS	192+61.10	V	25 MPH	CS	191+51.15	V	25 MPH
CS	192+61.10	Ls	100.00'	CS	191+51.15	Ls	100.00'
ST	193+61.10			ST	192+51.15		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

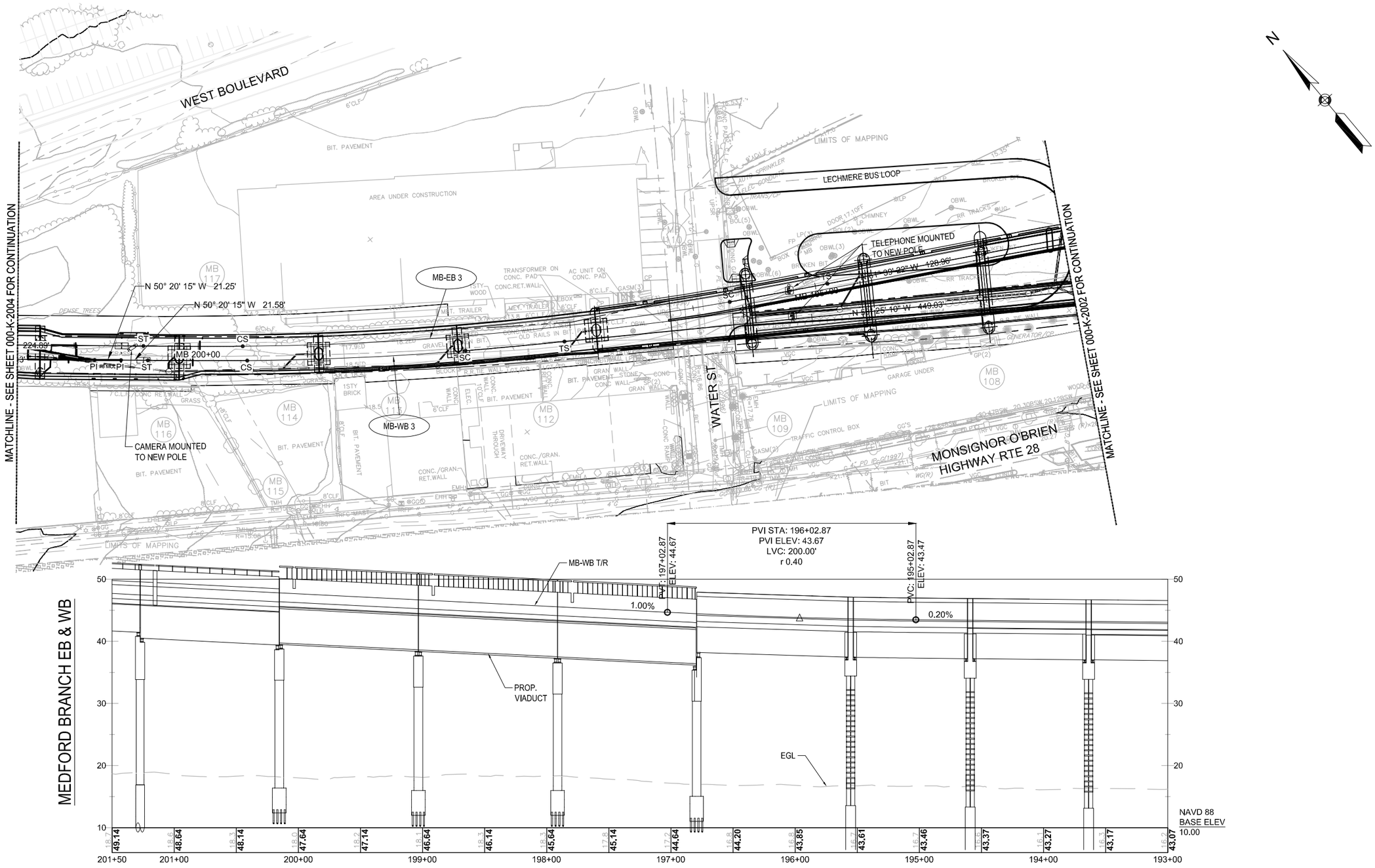
THE WALSH BARLETTA GRANITE
Joint Venture Team

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 184+500 TO STA. MB-WB 193+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2002



CURVE MB-EB 3				CURVE MB-WB 3			
TS	194+90.06	Ls	80.00'	TS	197+00.18	Ls	80.00'
SC	195+70.06			SC	197+80.18		
SC	195+70.06	Lc	394.12'	SC	197+80.18	Lc	175.94'
		R	2400.00'			R	2411.00'
		Ea	1.50"			Ea	1.50"
		Eu	0.00"			Eu	0.00"
CS	199+64.18	V	30 MPH	CS	199+56.12	V	30 MPH
CS	199+64.18	Ls	80.00'	CS	199+56.12	Ls	80.00'
ST	200+44.18			ST	200+36.12		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

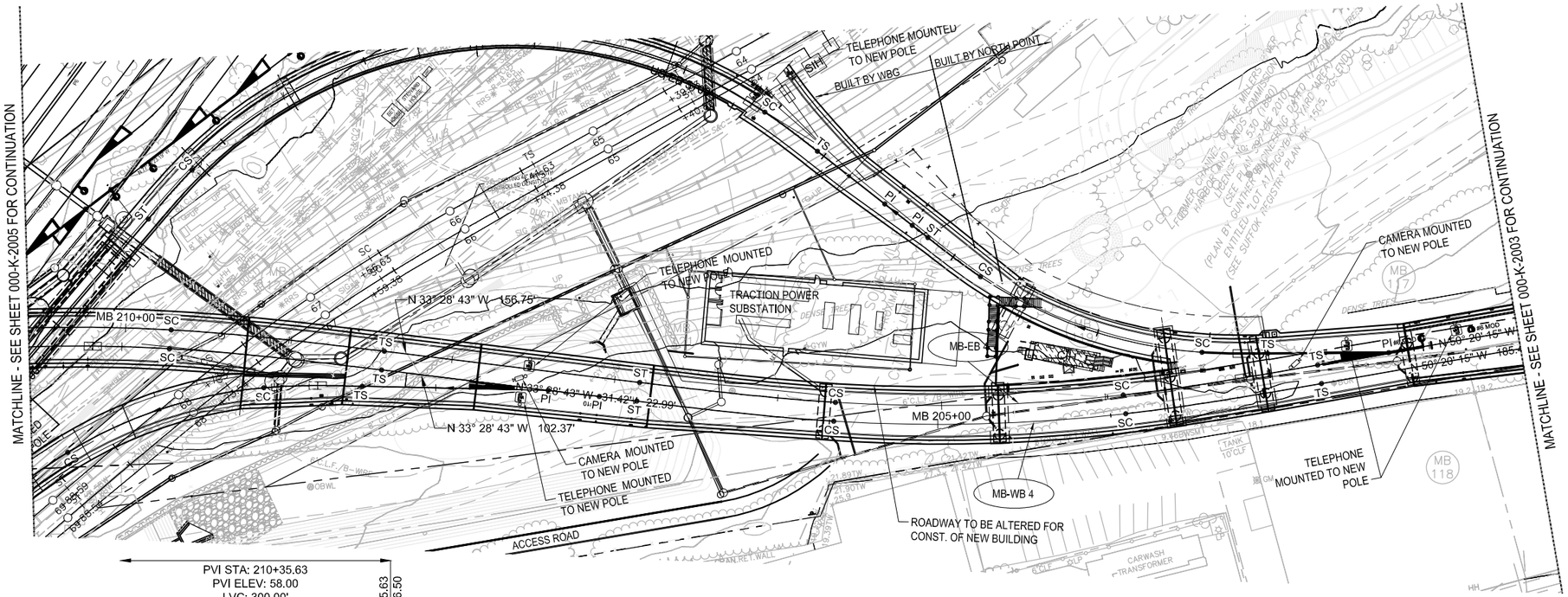
THE WALSH BARLETTA GRANITE
Joint Venture Team

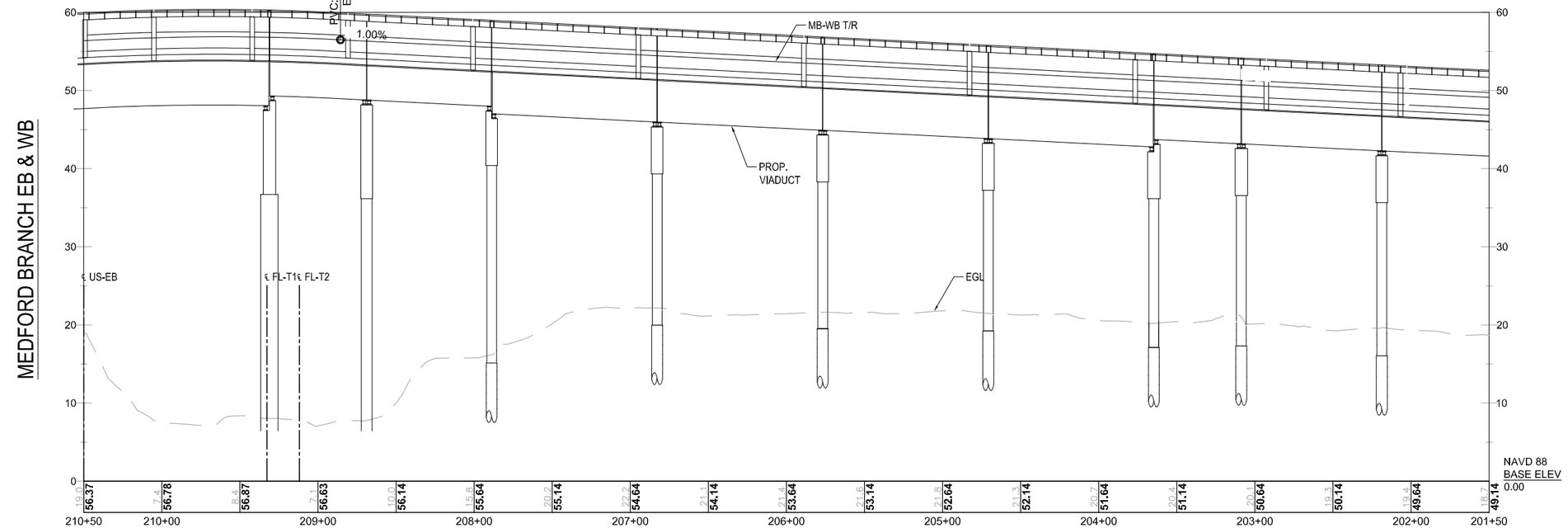
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 193+00 TO STA. MB-WB 201+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2003





CURVE MB-EB 4				CURVE MB-WB 4				CURVE MB-EB 5				CURVE MB-WB 5			
TS	202+69.07	Ls	120.00'	TS	202+64.37	Ls	120.69'	TS	208+41.53	Ls	130.74'	TS	208+40.93	Ls	130.00'
SC	203+89.07			SC	203+85.06			SC	209+72.27			SC	209+70.93		
SC	203+89.07	Lc	175.71'	SC	203+85.06	Lc	178.41'	SC	209+72.27	Lc	194.16'	SC	209+70.93	Lc	191.23'
		R	1005.00'			R	1016.50'			R	1016.50'			R	1005.00'
		Ea	3.00"			Ea	3.00"			Ea	3.25"			Ea	3.25"
		Eu	0.59"			Eu	0.55"			Eu	0.30"			Eu	0.34"
CS	205+64.78	V	30 MPH	CS	205+63.47	V	30 MPH	CS	211+66.43	V	30 MPH	CS	211+62.16	V	30 MPH
CS	205+64.78	Ls	120.00'	CS	205+63.47	Ls	120.68'	CS	211+66.43	Ls	130.74'	CS	211+62.16	Ls	130.00'
ST	206+84.78			ST	206+84.15			ST	212+97.17			ST	212+92.16		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

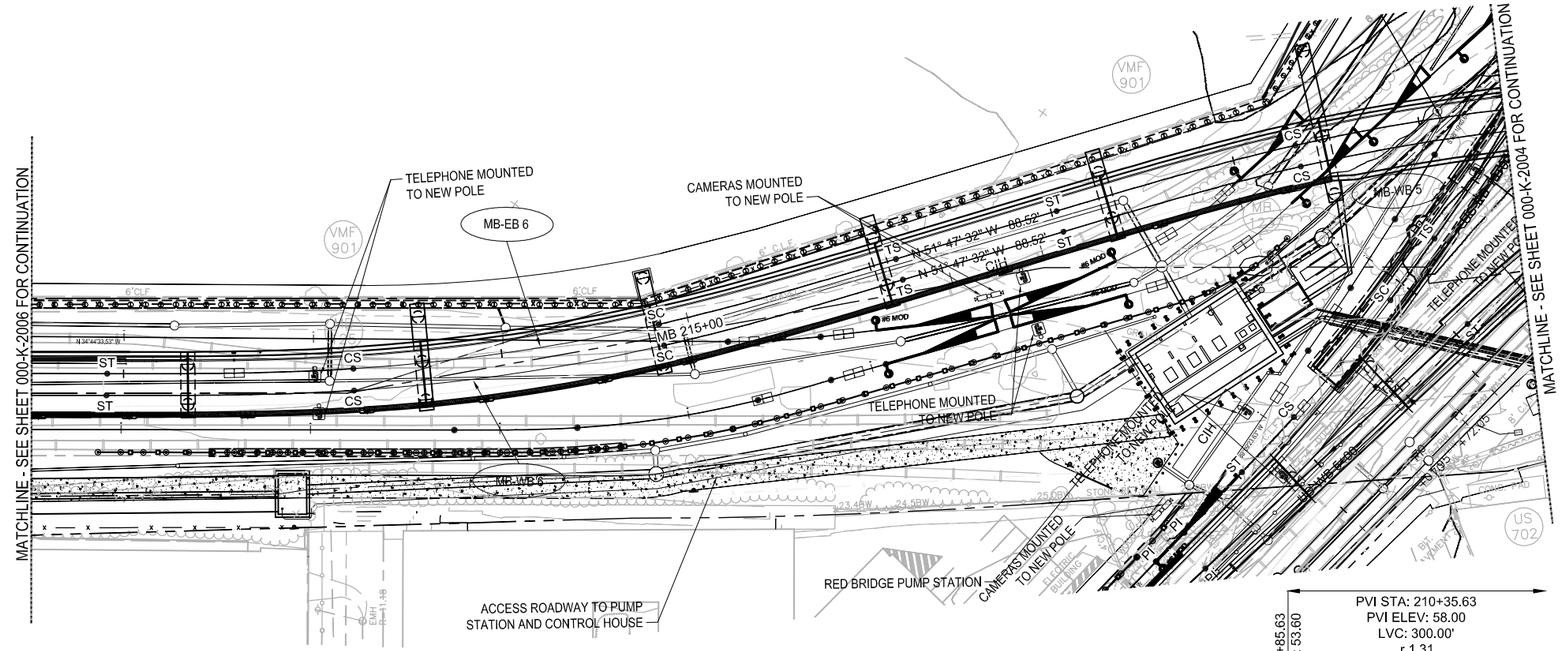
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

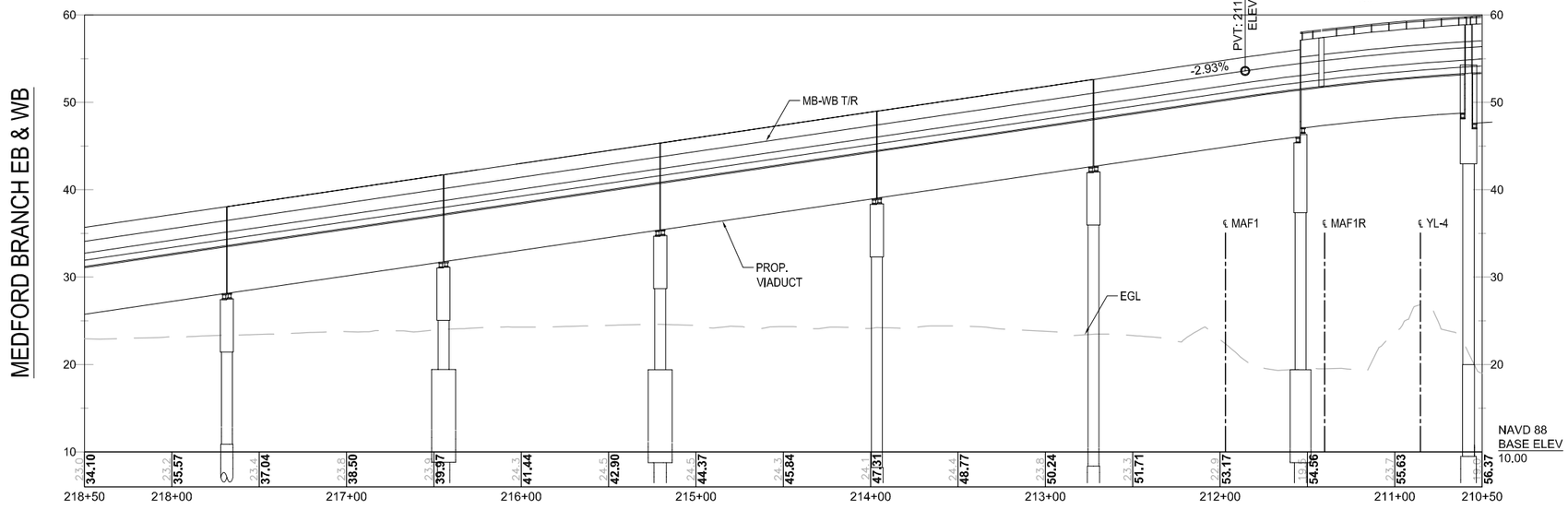
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 201+50 TO STA. MB-WB 210+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2004


MATCHLINE - SEE SHEET 000-K-2006 FOR CONTINUATION
TELEPHONE MOUNTED TO NEW POLE
MB-EB 6
CAMERAS MOUNTED TO NEW POLE
VMF 901
MB-WB 5
MB-WB 6
MB 215+00
N 54° 47' 32" W 88.52'
TELEPHONE MOUNTED TO NEW POLE
RED BRIDGE PUMP STATION
CAMERAS MOUNTED TO NEW POLE
ACCESS ROADWAY TO PUMP STATION AND CONTROL HOUSE
MATCHLINE - SEE SHEET 000-K-2004 FOR CONTINUATION
US 702
N



CURVE MB-EB 6				CURVE MB-WB 6			
TS	213+85.69	Ls	130.00'	TS	213+80.67	Ls	130.74'
SC	215+15.69			SC	215+11.41		
SC	215+15.69	Lc	162.97'	SC	215+11.41	Lc	165.58'
		R	1005.00'			R	1016.50'
		Ea	3.25''			Ea	3.25''
		Eu	0.34''			Eu	0.30''
CS	216+78.66	V	30 MPH	CS	216+76.99	V	30 MPH
CS	216+78.66	Ls	130.00'	CS	216+76.99	Ls	130.74'
ST	218+08.66			ST	218+07.73		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

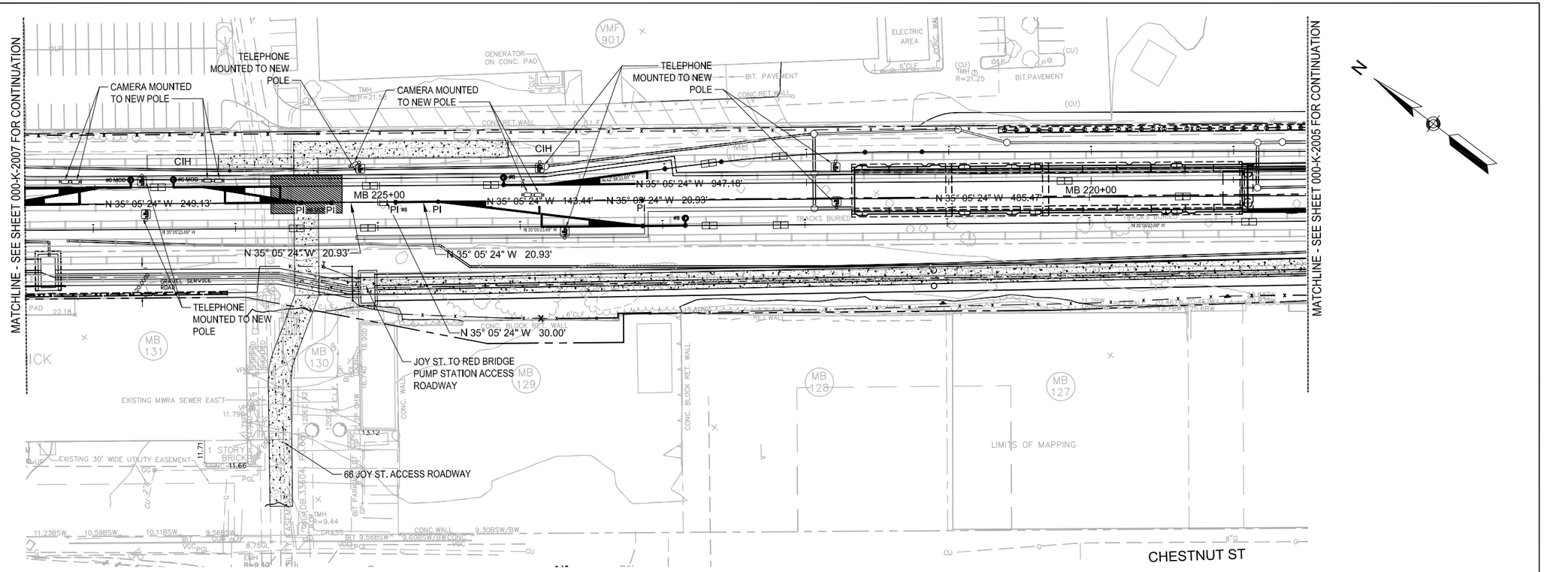
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

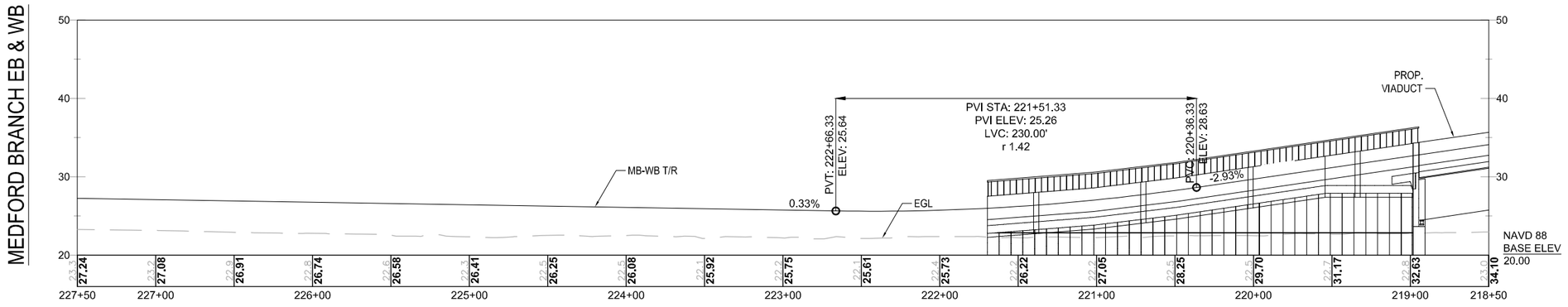
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 210+50 TO STA. MB-WB 218+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2005


MATCHLINE - SEE SHEET 000-K-2007 FOR CONTINUATION
MATCHLINE - SEE SHEET 000-K-2005 FOR CONTINUATION
TELEPHONE MOUNTED TO NEW POLE
CAMERA MOUNTED TO NEW POLE
CIH
MB 225+00
MB 220+00
N 35° 05' 24" W 249.13'
N 35° 05' 24" W 20.93'
N 35° 05' 24" W 30.00'
N 35° 05' 24" W 142.44'
N 35° 05' 24" W 947.18'
N 35° 05' 24" W 485.47'
JOY ST.. TO RED BRIDGE PUMP STATION ACCESS ROADWAY
66 JOY ST. ACCESS ROADWAY
EXISTING MWRA SEWER EAST
EXISTING 30' WIDE UTILITY EASEMENT
LIMITS OF MAPPING
CHESTNUT ST
MB 131
MB 130
MB 129
MB 128
MB 127
N



NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

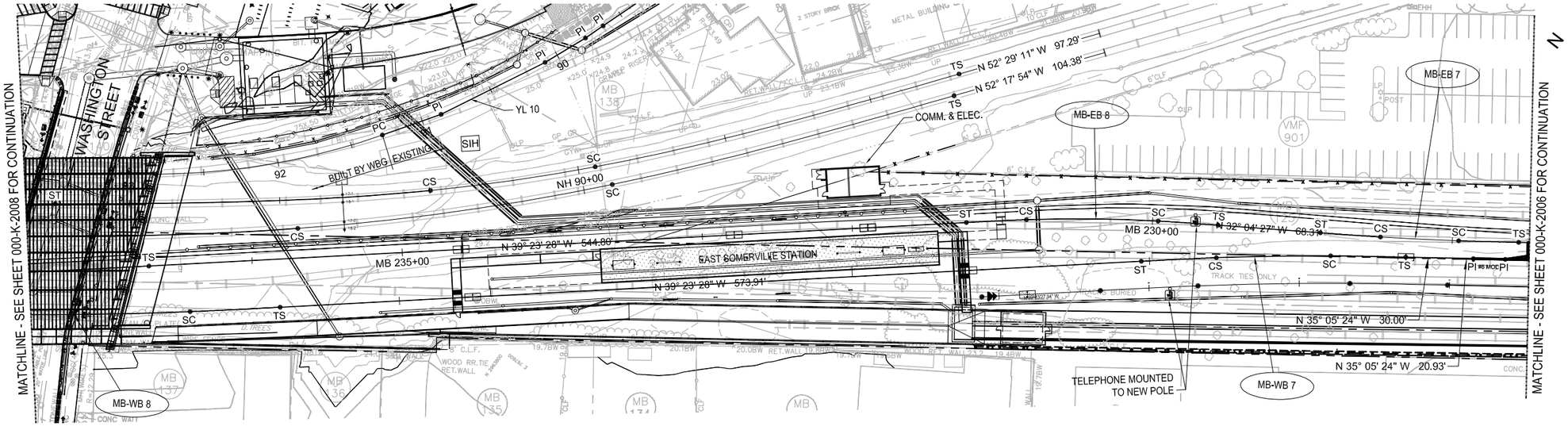
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

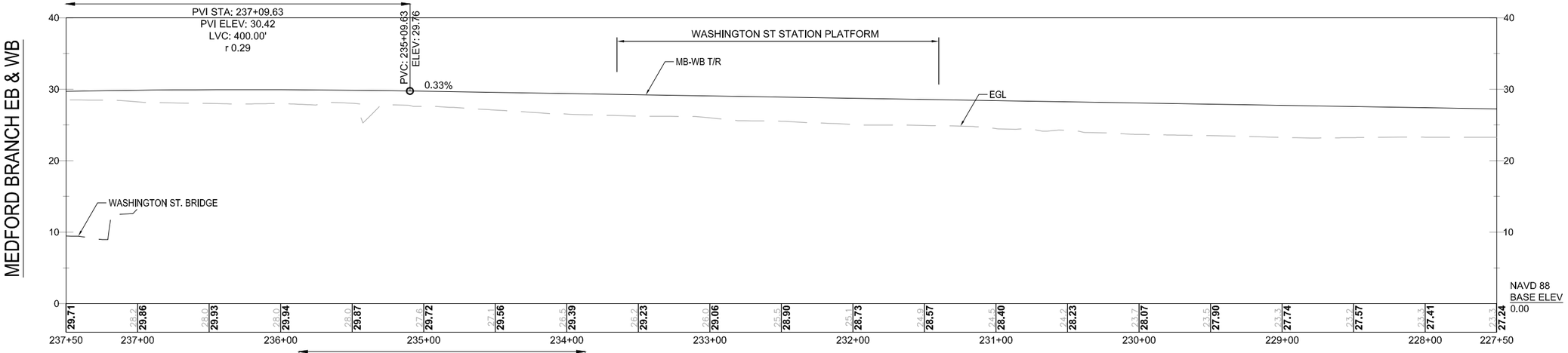
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

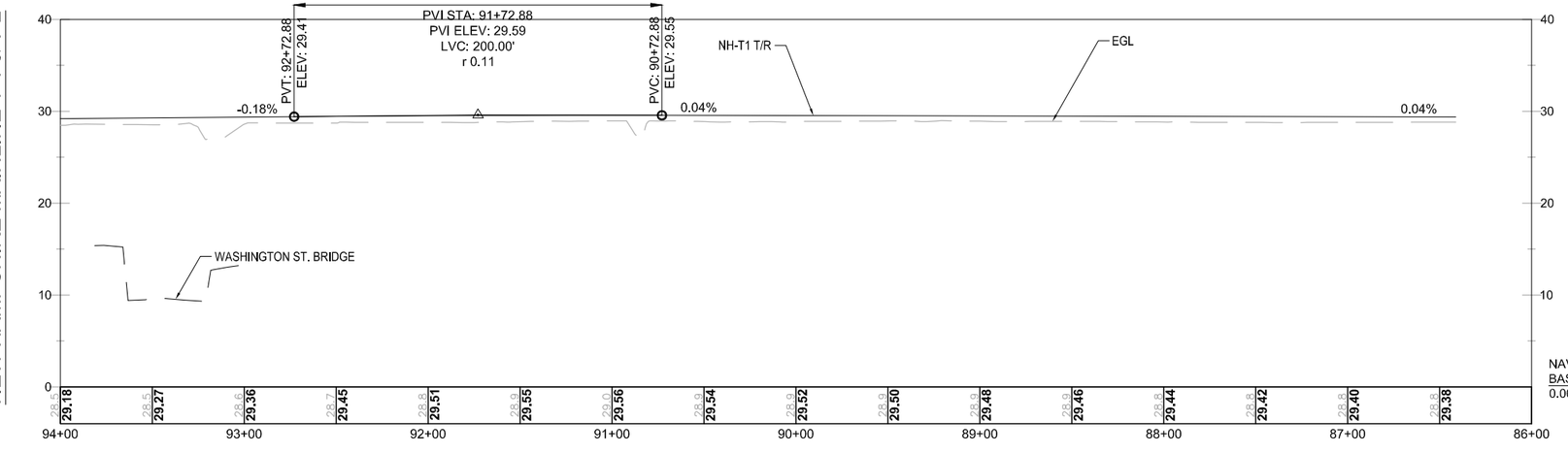
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 218+50 TO STA. MB-WB 227+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **000-K-2006**







CURVE PAR 06			
PC	91+28.19	Ls	0.00'
PC	91+28.19	Lc (Chord)	153.00'
		Dc	12°28'31.00"
		Ea	0.00"
		Eu	1.96"
PT	92+81.91	V	15 MPH
PT	92+81.91	Ls	0.00'

CURVE NH-T1 07			
TS	87+38.60	Ls	250.00'
SC	89+88.60		
SC	89+88.60	Lc (Chord)	110.80'
		Dc	4°25'00.00"
		Ea	2.00"
		Eu	1.79"
CS	90+99.43	V	35 MPH
CS	90+99.43	Ls	250.00'
ST	93+49.43		

CURVE NH-T2 07			
TS	87+45.84	Ls	235.00'
SC	89+80.84		
SC	89+80.84	Lc (Chord)	211.25'
		Dc	3°35'00.00"
		Ea	2.00"
		Eu	1.07"
CS	91+92.26	V	35 MPH
CS	91+92.26	Ls	235.00'
ST	94+27.26		

CURVE MB-EB 7			
TS	227+55.84	Ls	40.00'
SC	227+95.84		
SC	227+95.84	Lc	52.11'
		R	1750.00'
		Ea	1.00"
		Eu	0.43"
CS	228+47.95	V	25 MPH
CS	228+47.95	Ls	40.00'
ST	228+87.95		

CURVE MB-EB 8			
TS	229+56.26	Ls	40.00'
SC	229+96.26		
SC	229+96.26	Lc	87.70'
		R	1000.00'
		Ea	0.75"
		Eu	0.85"
CS	230+83.96	V	25 MPH
CS	230+83.96	Ls	40.00'
ST	231+23.96		

CURVE MB-WB 7			
TS	228+29.48	Ls	50.00'
SC	228+79.48		
SC	228+79.48	Lc	76.12'
		R	1680.00'
		Ea	1.00"
		Eu	0.49"
CS	229+55.60	V	25 MPH
CS	229+55.60	Ls	50.00'
ST	230+05.60		

CURVE MB-WB 8			
TS	235+79.50	Ls	60.00'
SC	236+39.50		
SC	236+39.50	Lc	120.42'
		R	2450.00'
		Ea	1.25"
		Eu	0.22"
CS	237+59.92	V	30 MPH
CS	237+59.92	Ls	60.00'
ST	238+19.92		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

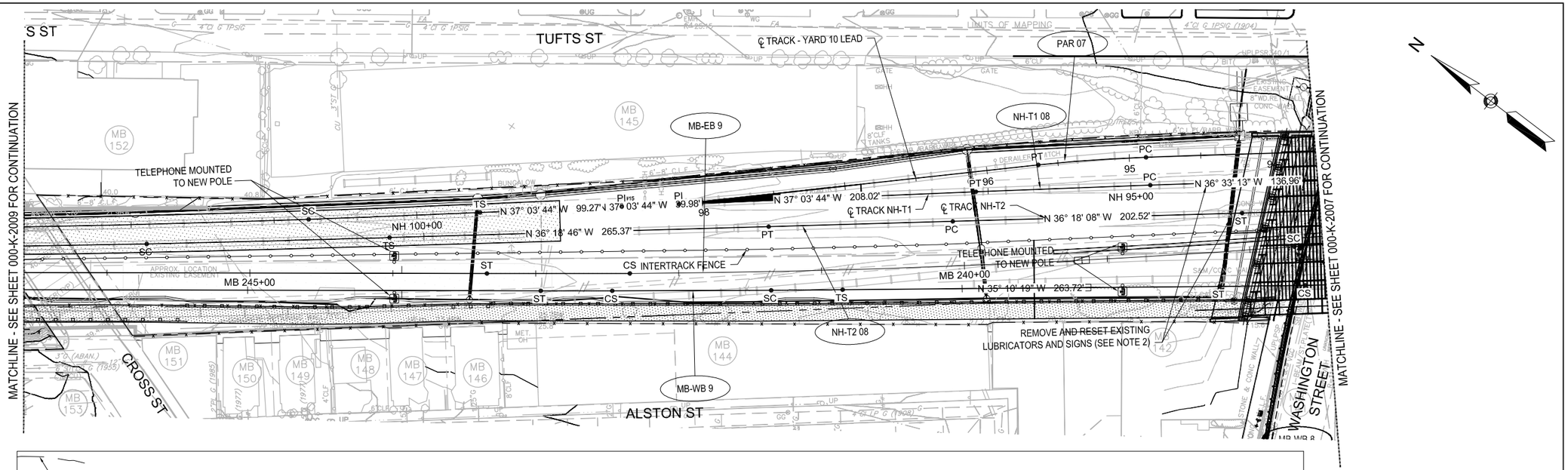
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

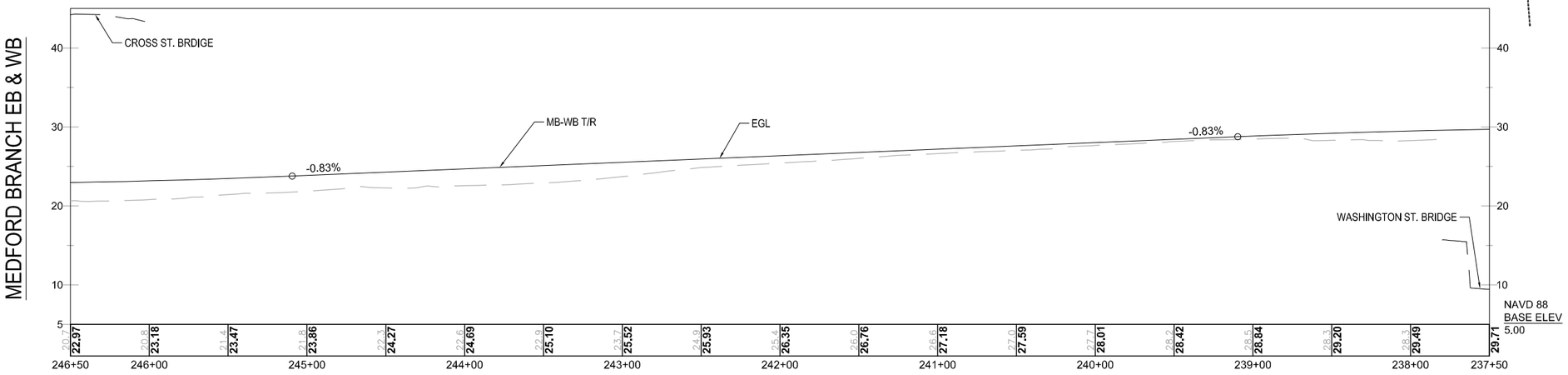
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

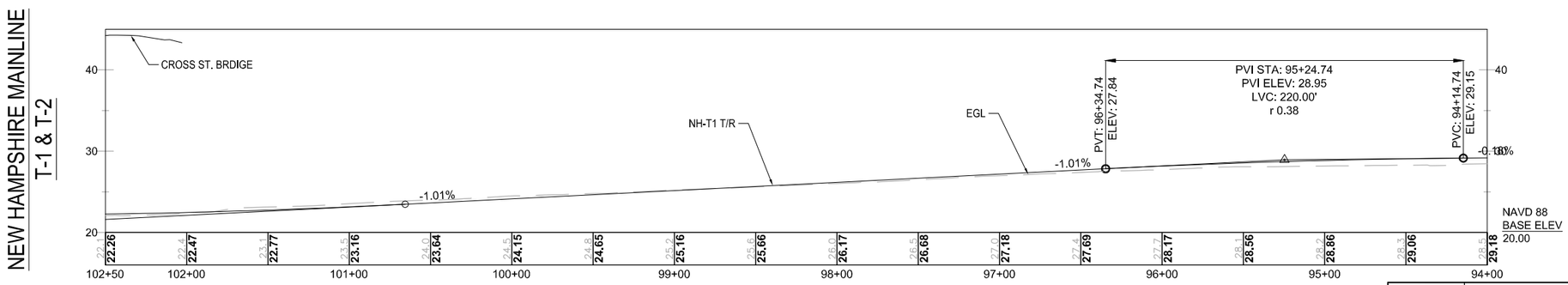
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 227+50 TO STA. MB-WB 237+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2007







CURVE NH-T1 08				CURVE NH-T2 08			
PC	94+86.39	Ls	0.00'	PC	96+29.77	Ls	0.00'
SC	94+86.39	Lc (Chord)	122.08'	SC	96+29.77	Lc (Chord)	128.81'
		Dc	0°25'00.00"			Dc	0°00'30.00"
		Ea	0.00"			Ea	0.00"
		Eu	0.36"			Eu	0.01"
CS	96+08.47	V	35 MPH	CS	97+58.60	V	35 MPH
PT	96+08.47	Ls	0.00'	PT	97+58.60	Ls	0.00'

CURVE MB-EB 9				CURVE MB-WB 9				CURVE PAR 07			
TS	236+68.76	Ls	100.00'	TS	240+83.64	Ls	50.00'	PC	94+88.28	Ls	0.00'
SC	237+68.76			SC	241+33.64						
SC	237+68.76	Lc	465.40'	SC	241+33.64	Lc	111.21'	SC	94+88.28	Lc (Chord)	75.50'
		R	6700.00'			R	15000.00'			Dc	5°43'47.00"
		Ea	1.25"			Ea	0.25"			Ea	0.00"
		Eu	0.25"			Eu	0.42"			Eu	0.90"
CS	242+34.16	V	50 MPH	CS	242+44.85	V	50 MPH	CS	95+63.80	V	15 MPH
CS	242+34.16	Ls	100.00'	CS	242+44.85	Ls	50.00'	PT	95+63.80	Ls	0.00'
ST	243+34.16			ST	242+94.85						

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

4-171

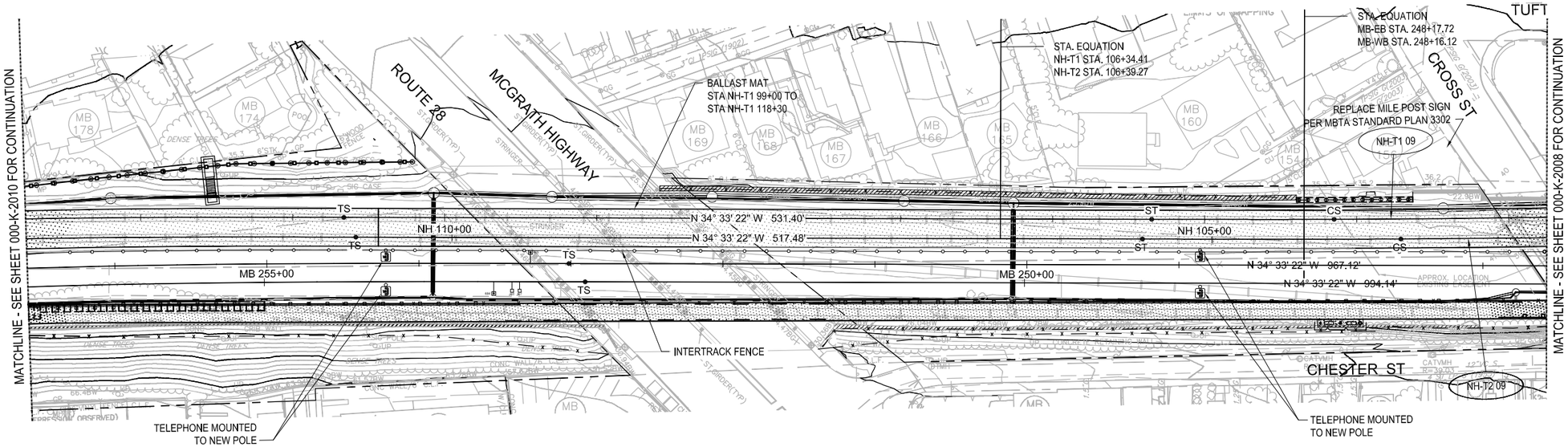
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

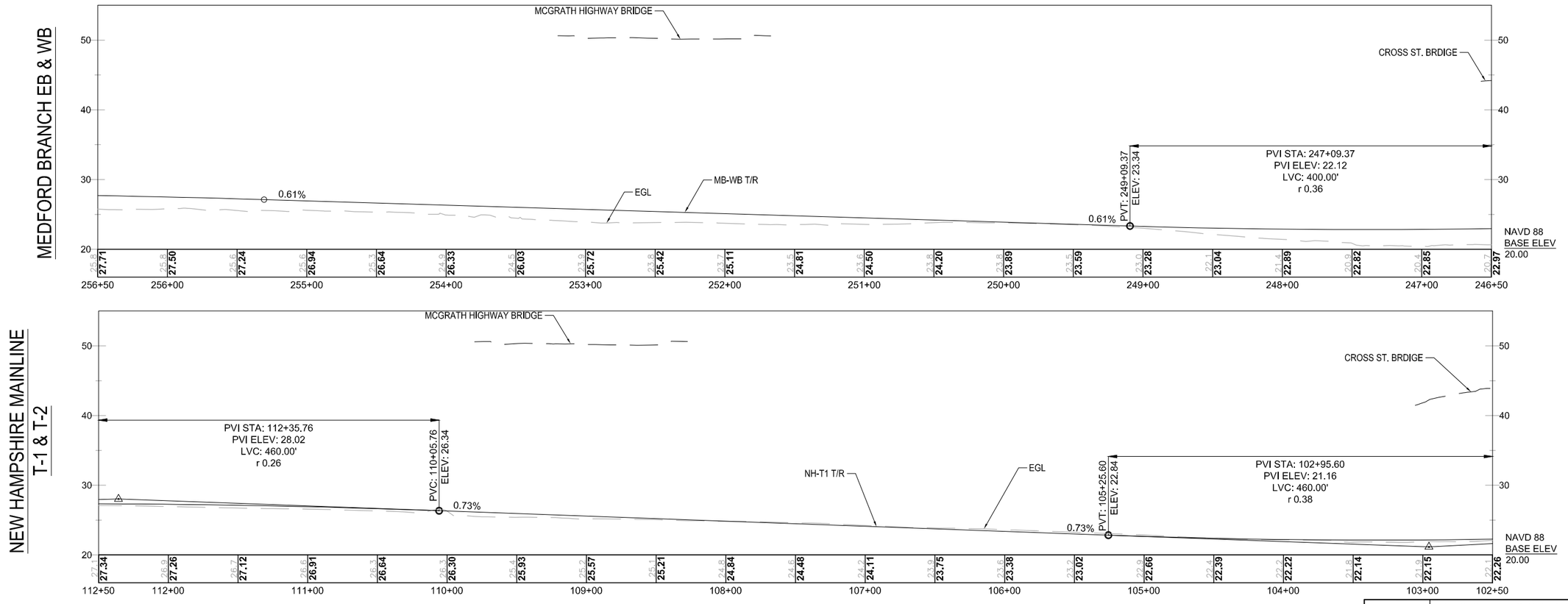
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 237+50 TO STA. MB-WB 246+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2008





CURVE NH-T1 09				CURVE NH-T2 09			
TS	99+55.73	Ls	120.00'	TS	100+23.96	Ls	170.00'
SC	100+75.73			SC	101+93.96		
SC	100+75.73	Lc (Chord)	339.13'	SC	101+93.96	Lc (Chord)	181.78'
		Dc	0°32'45.00"			Dc	0°29'57.84"
		Ea	1.25"			Ea	1.00"
		Eu	0.62"			Eu	0.71"
CS	104+14.87	V	70 MPH	CS	103+75.74	V	70 MPH
CS	104+14.87	Ls	120.00'	CS	103+75.74	Ls	170.00'
ST	105+34.87			ST	105+45.74		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

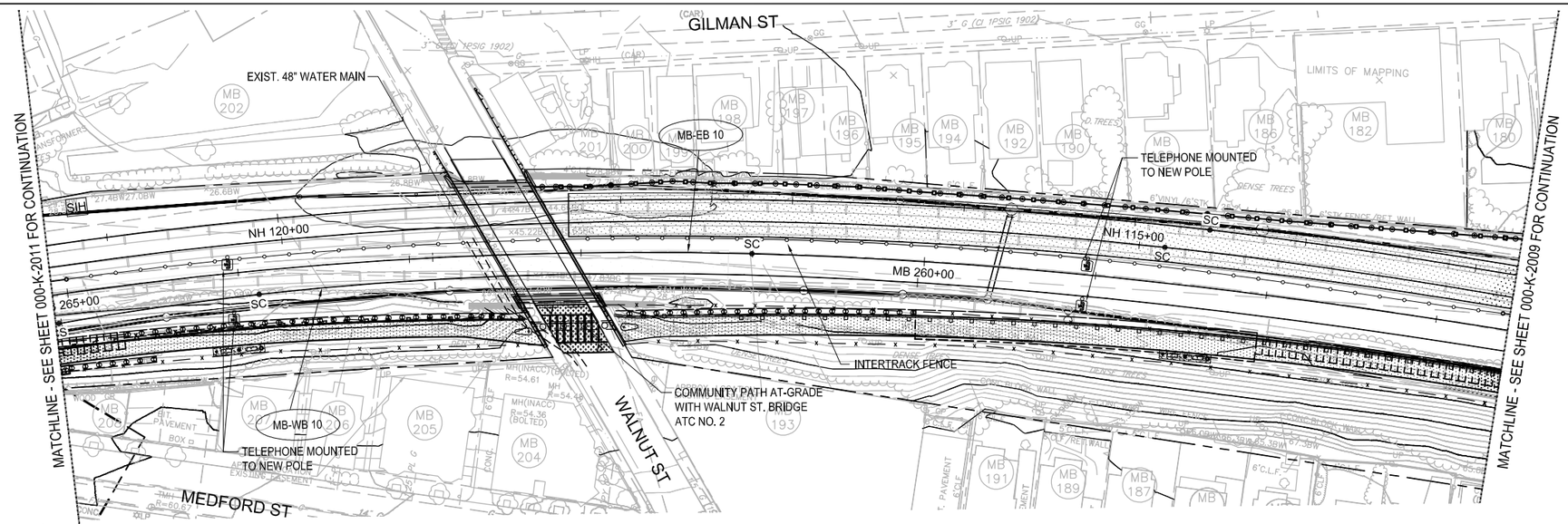
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

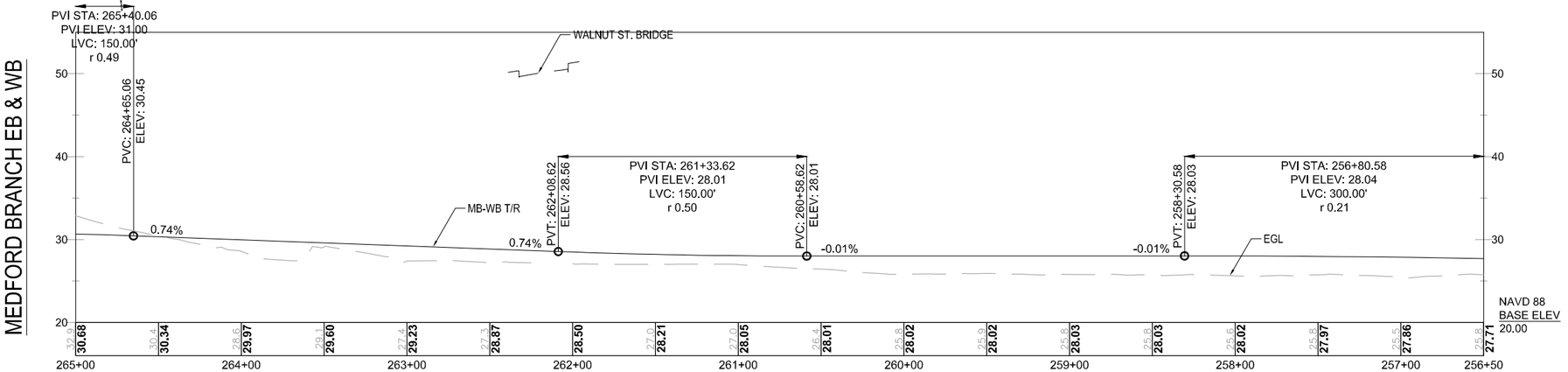
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 246+50 TO STA. MB-WB 256+50

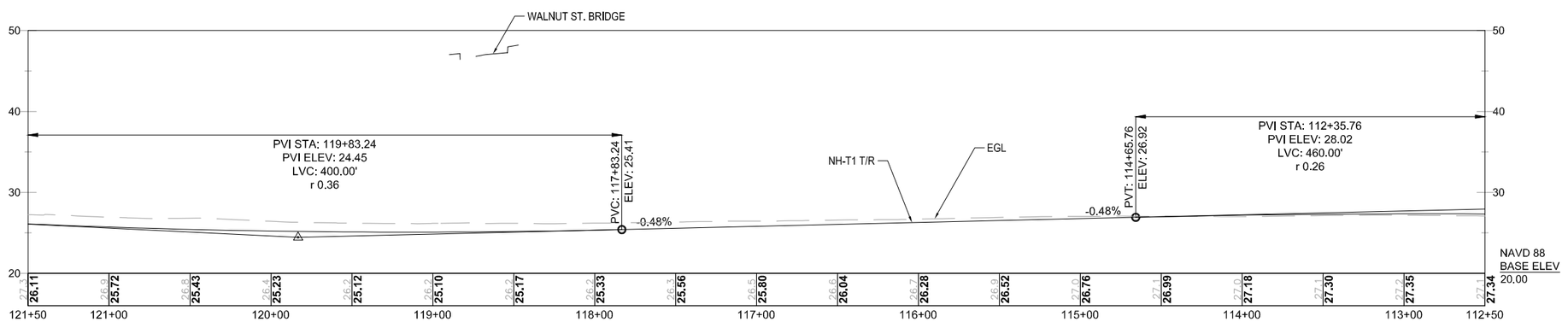
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2009



MEDFORD BRANCH EB & WB



NEW HAMPSHIRE MAINLINE T-1 & T-2



CURVE MB-EB 10				CURVE MB-WB 10				CURVE NH-T1 10				CURVE NH-T2 10			
TS	253+01.28	Ls	799.17'	TS	252+88.98	Ls	1094.82'	TS	110+66.27	Ls	390.00'	TS	110+63.22	Ls	421.82'
SC	261+00.45			SC	263+83.80			SC	114+56.27			SC	114+85.04		
SC	261+00.45	Lc	500.33'	SC	263+83.80	Lc	117.82'	SC	114+56.27	Lc (Chord)	729.69'	SC	114+85.04	Lc (Chord)	683.53'
		R	2400.00'			R	1800.00'			Dc	2°12'13.32"			Dc	2°14'48.84"
		Ea	2.00"			Ea	2.00"			Ea	3.75"			Ea	3.75"
		Eu	0.67"			Eu	1.56"			Eu	2.77"			Eu	2.90"
CS	266+00.78	V	40 MPH	CS	265+01.62	V	40 MPH	CS	121+88.37	V	65 MPH	CS	121+70.63	V	65 MPH
CS	266+00.78	Ls	278.77'	CS	265+01.62	Ls	228.49'	CS	121+88.37	Ls	390.00'	CS	121+70.63	Ls	408.22'
ST	268+79.55			ST	267+30.11			ST	125+78.37			ST	125+78.85		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

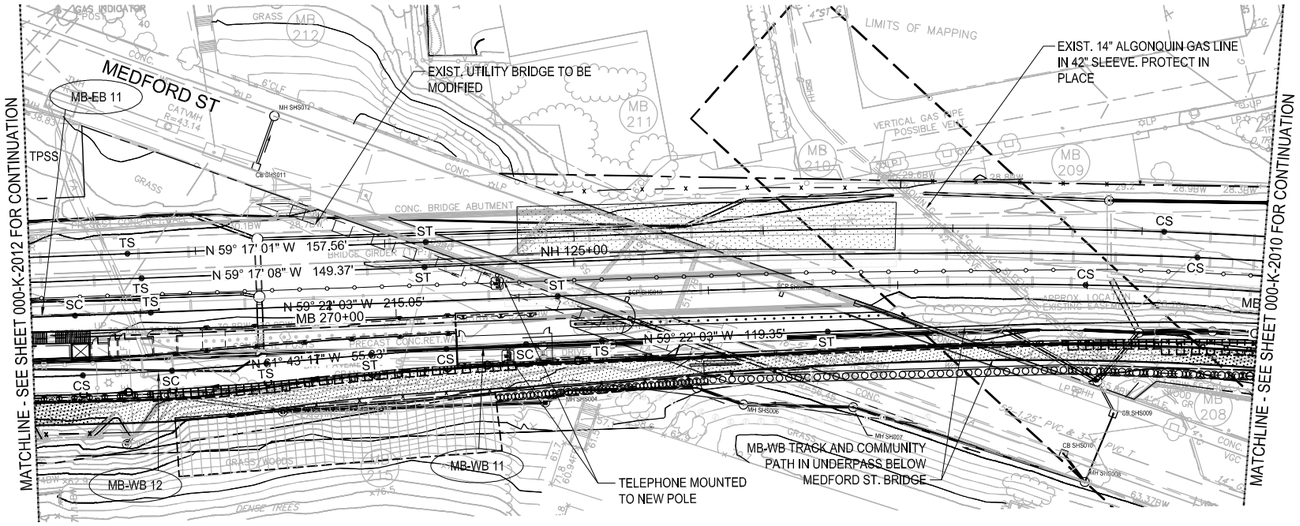
THE WALSH BARLETTA GRANITE
Joint Venture Team

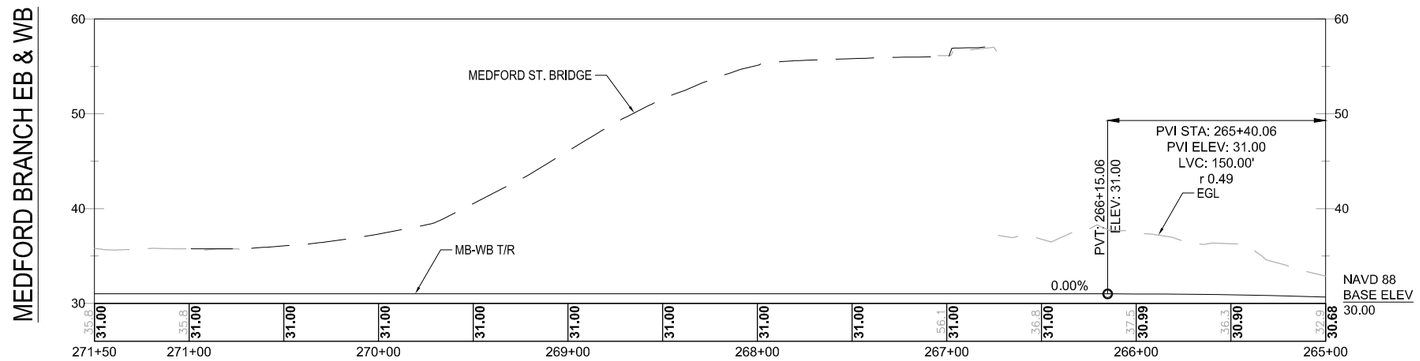
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

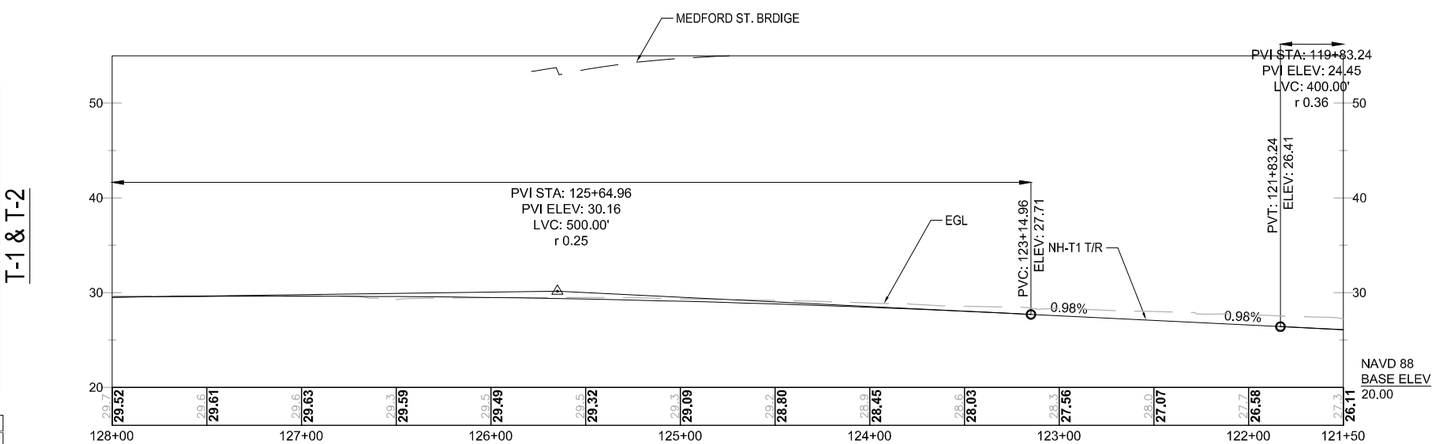
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 256+50 TO STA. MB-WB 265+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2010


MEDFORD ST
MB-EB 11
MB-WB 12
MB-WB 11
EXIST. UTILITY BRIDGE TO BE MODIFIED
EXIST. 14" ALGONQUIN GAS LINE IN 42" SLEEVE. PROTECT IN PLACE
TELEPHONE MOUNTED TO NEW POLE
MB-WB TRACK AND COMMUNITY PATH IN UNDERPASS BELOW MEDFORD ST. BRIDGE
LIMITS OF MAPPING
MATCHLINE - SEE SHEET 000-K-2012 FOR CONTINUATION
MATCHLINE - SEE SHEET 000-K-2010 FOR CONTINUATION
N 59° 17' 01" W 157.56'
N 59° 17' 08" W 149.37'
N 59° 22' 03" W 215.05'
N 59° 22' 03" W 119.35'
N 64° 43' 17" W 55.83'
NH 125+00
MB 270+00





CURVE MB-EB 11			
TS	270+94.61	Ls	40.00'
SC	271+34.61		
SC	271+34.61	Lc	43.37'
		R	5200.00'
		Ea	1.00"
		Eu	0.23"
CS	271+77.98	V	40 MPH
CS	271+77.98	Ls	40.00'
ST	272+17.98		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

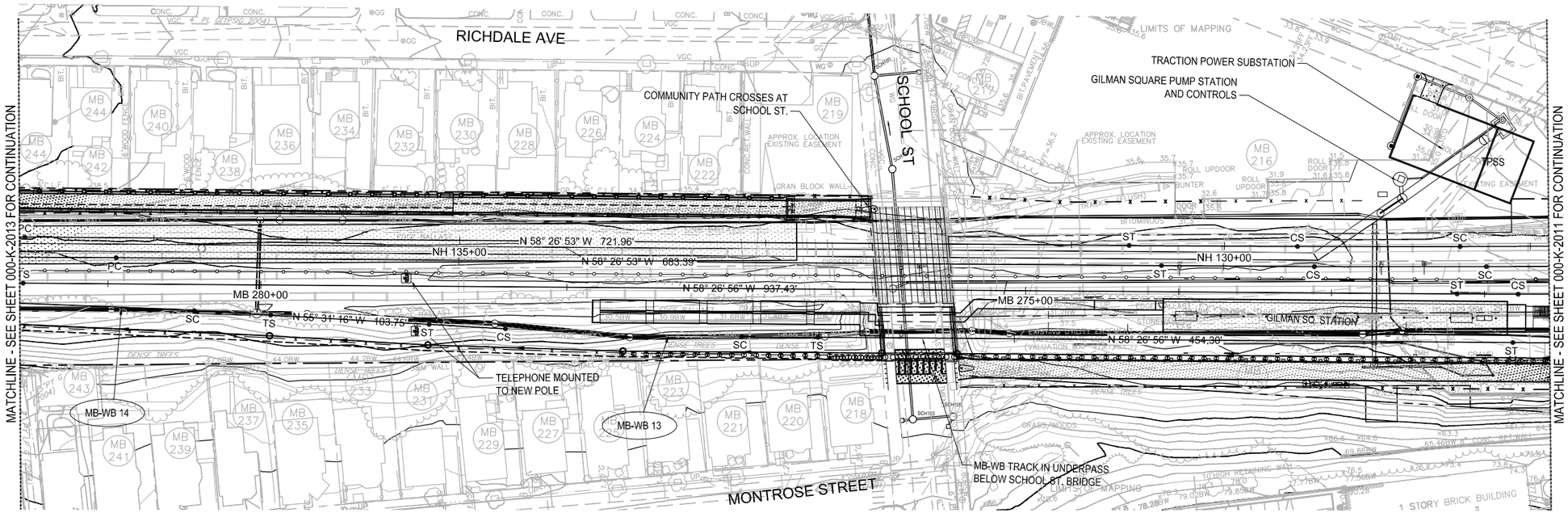
THE WALSH BARLETTA GRANITE
Joint Venture Team

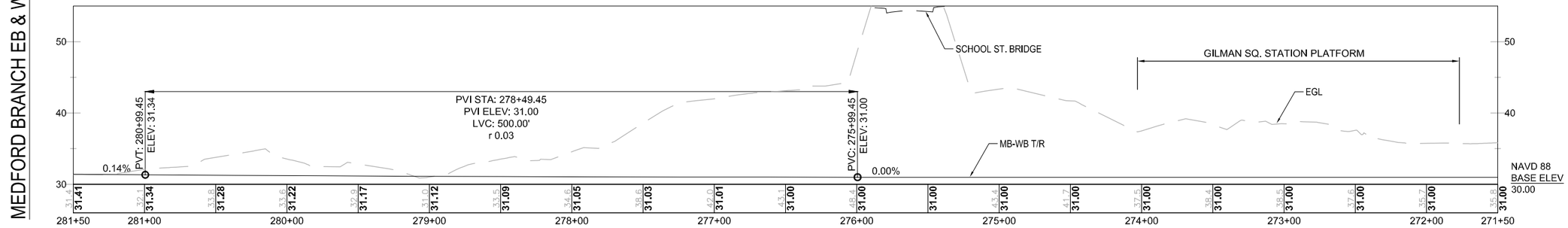
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

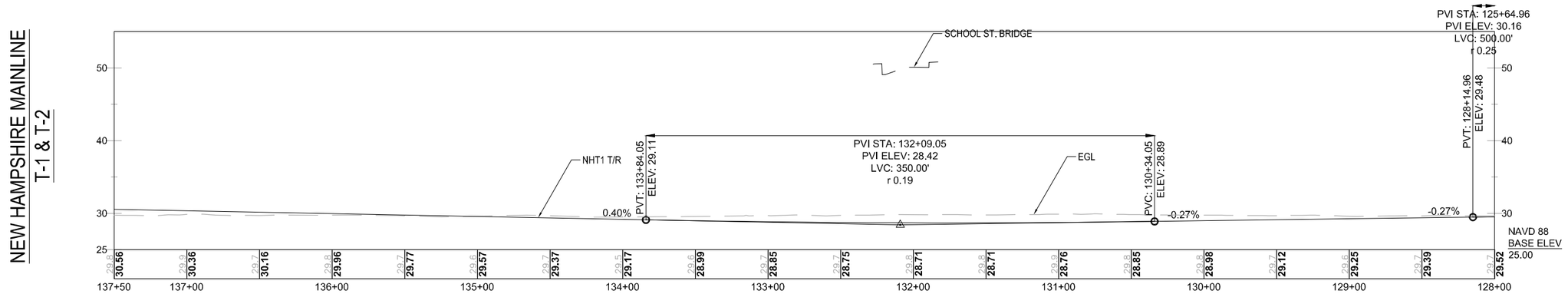
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 265+00 TO STA. MB-WB 271+50

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET 000-K-2011







CURVE MB-WB 11				CURVE MB-WB 12				CURVE MB-WB 13				CURVE MB-WB 14			
TS	268+49.47	Ls	40.00'	TS	270+26.97	Ls	50.00'	TS	276+28.36	Ls	50.00'	TS	279+86.51	Ls	50.00'
SC	268+89.47			SC	270+76.97			SC	276+78.36			SC	280+36.51		
SC	268+89.47	Lc	42.16'	SC	270+76.97	Lc	47.10'	SC	276+78.36	Lc	154.39'	SC	280+36.51	Lc	265.74'
		R	2000.00'			R	1700.00'			R	4000.00'			R	5000.00'
		Ea	2.00"			Ea	2.00"			Ea	1.00"			Ea	1.00"
		Eu	1.21"			Eu	1.77"			Eu	0.60"			Eu	0.28"
CS	269+31.63	V	40 MPH	CS	271+24.07	V	40 MPH	CS	278+32.75	V	40 MPH	CS	283+02.25	V	40 MPH
CS	269+31.63	Ls	40.00'	CS	271+24.07	Ls	50.00'	CS	278+32.75	Ls	50.00'	CS	283+02.25	Ls	50.00'
ST	269+71.63			ST	271+74.07			ST	278+82.75			ST	283+52.25		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

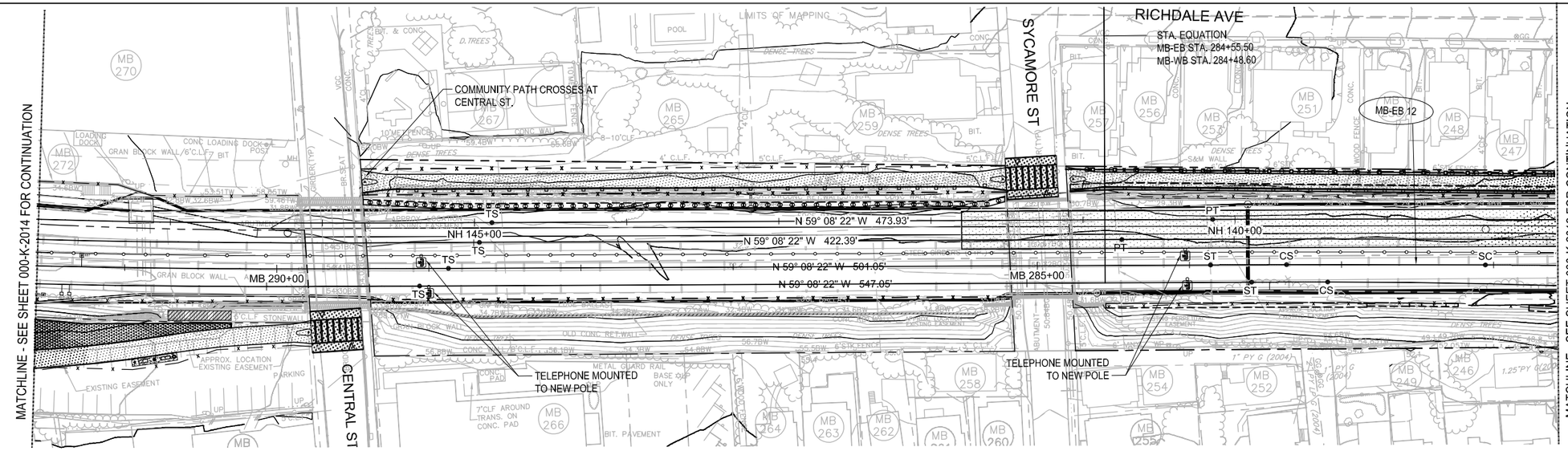
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

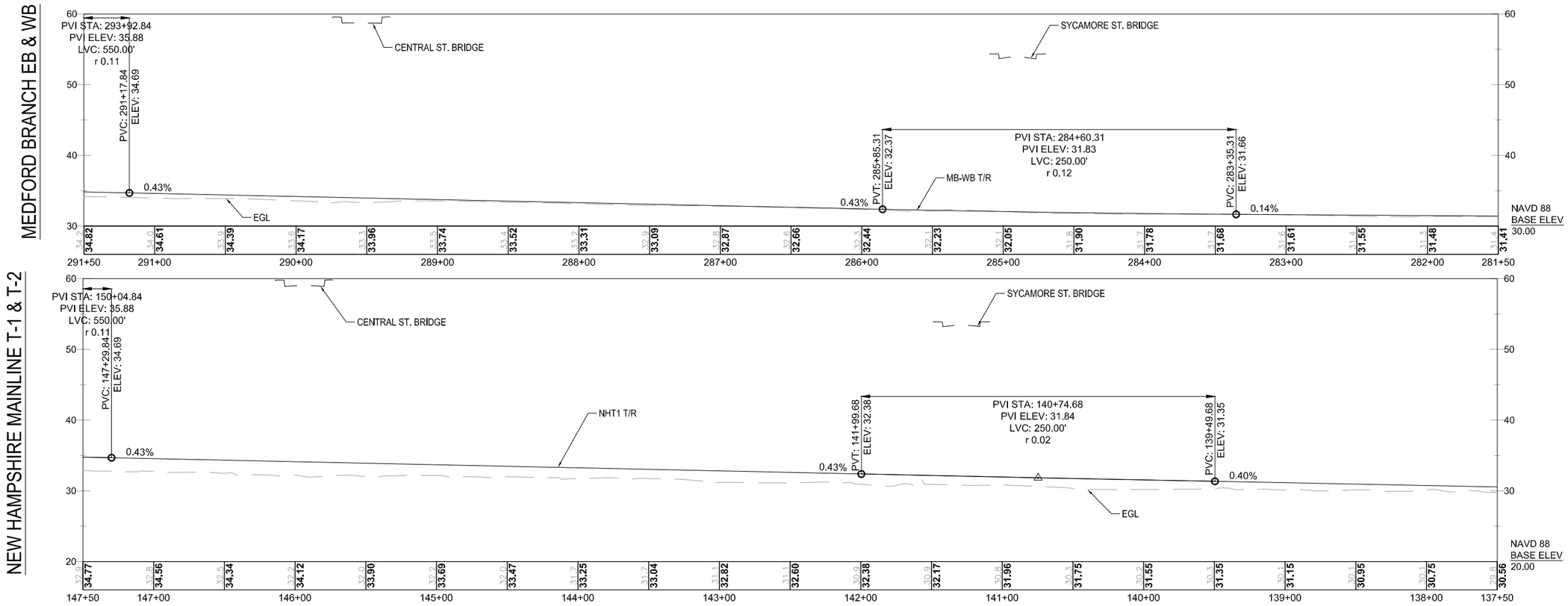
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 271+50 TO STA. MB-WB 281+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2012





CURVE MB-EB 12			
TS	281+55.40	Ls	50.00'
SC	282+05.40		
SC	282+05.40	Lc	130.76'
		R	15000.00'
		Ea	0.00"
		Eu	0.43"
CS	283+36.16	V	40 MPH
CS	283+36.16	Ls	50.00'
ST	283+86.16		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

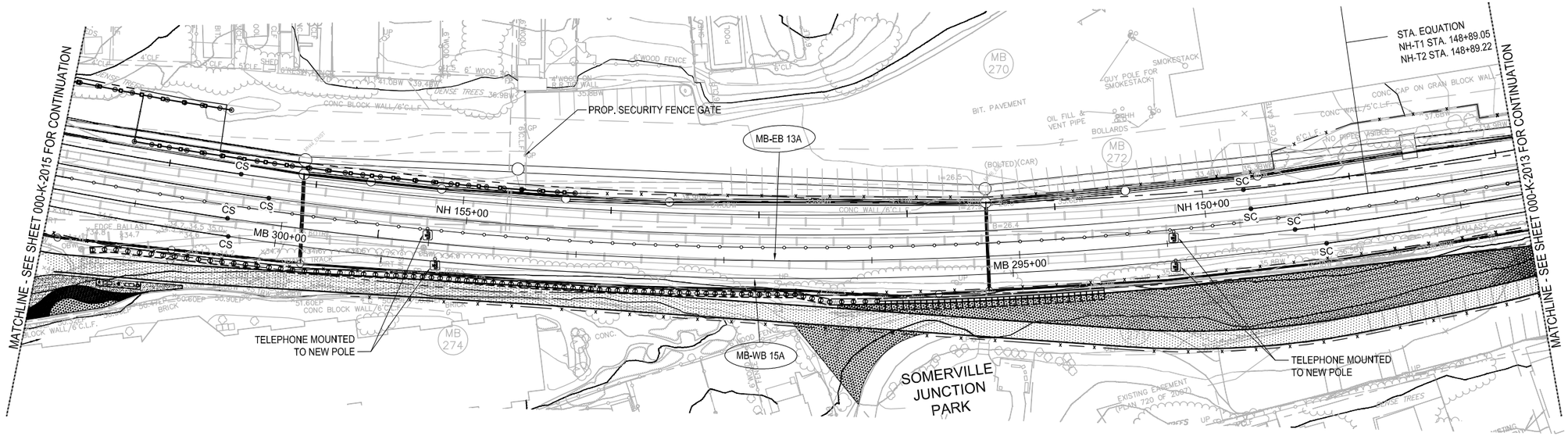
THE WALSH BARLETTA GRANITE
Joint Venture Team

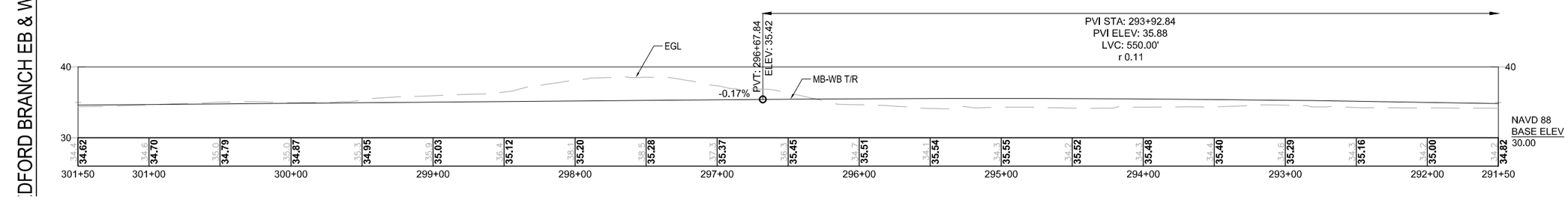
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

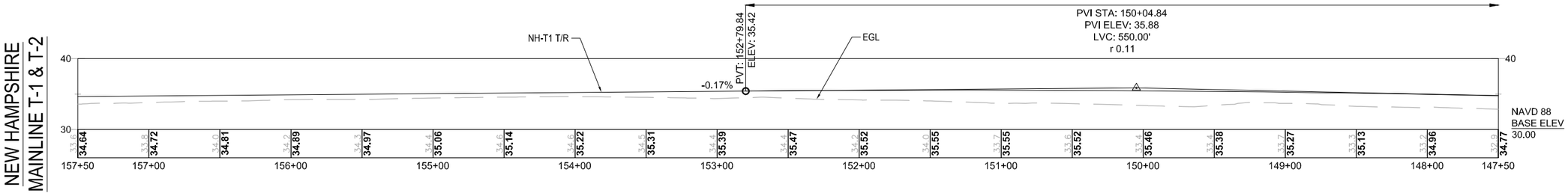
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH CORRIDOR PLAN
STA. MB-WB 281+50 TO STA. MB-WB 291+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2013







CURVE MB-EB 13A				CURVE MB-WB 15A				CURVE NH-T1 11				CURVE NH-T2 11			
TS	288+87.21	Ls	425.92'	TS	288+99.30	Ls	387.92'	TS	127+35.93	Ls	110.00'	TS	127+28.22	Ls	100.00'
SC	293+13.13			SC	292+87.22			SC	128+45.93			SC	128+28.22		
SC	293+13.13	Lc	723.69'	SC	292+87.22	Lc	744.64'	SC	128+45.93	Lc (Chord)	106.41'	SC	128+28.22	Lc (Chord)	112.38'
		R	2632.92'			R	2644.92'			Dc	0°23'10.00"			Dc	0°23'39.58"
		Ea	2.00"			Ea	2.00"			Ea	1.00"			Ea	1.00"
		Eu	0.44"			Eu	0.43"			Eu	0.73"			Eu	0.77"
CS	300+36.82	V	40 MPH	CS	300+31.86	V	40 MPH	CS	129+52.34	V	80 MPH	CS	129+40.60	V	80 MPH
CS	300+36.82	Ls	130.77'	CS	300+31.86	Ls	131.29'	CS	129+52.34	Ls	110.00'	CS	129+40.60	Ls	100.00'
SC	301+67.59			SC	301+63.15			ST	130+62.34			ST	130+40.60		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

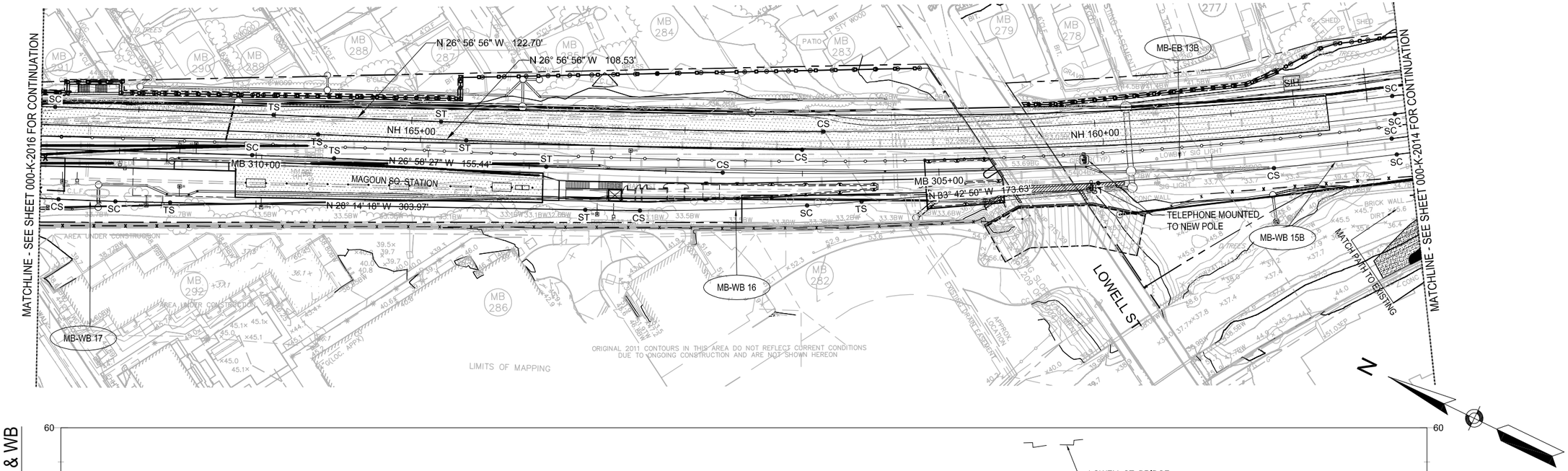
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

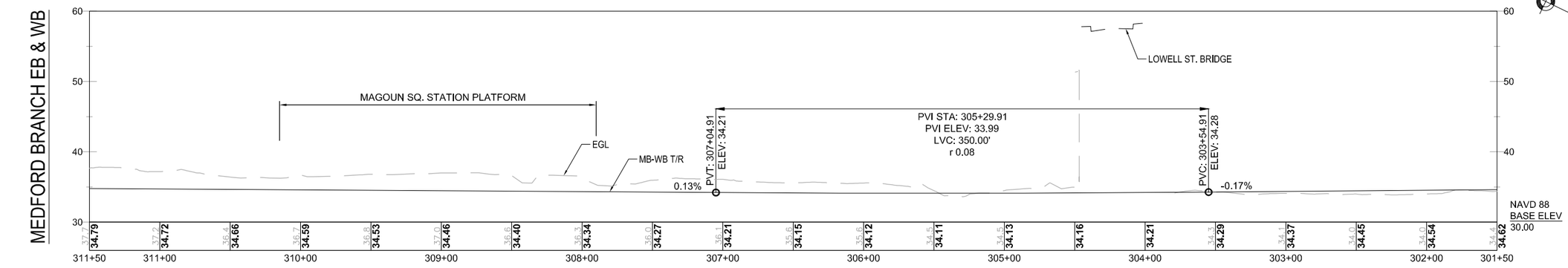
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

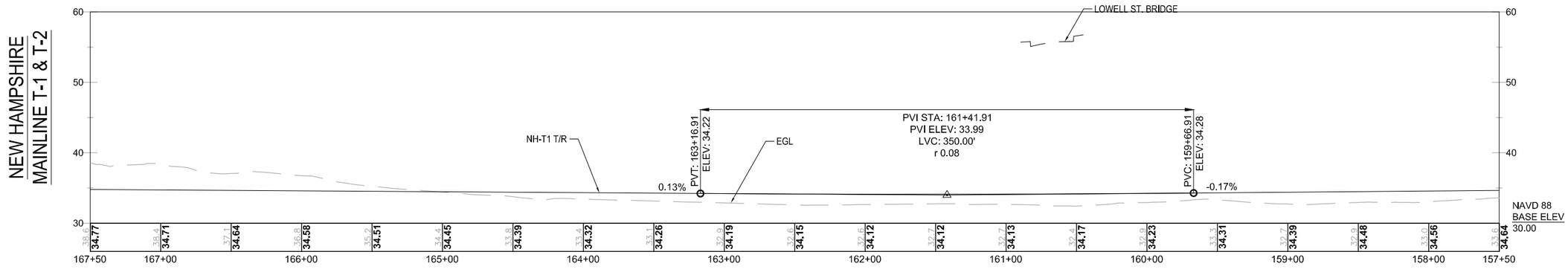
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 291+50 TO STA. MB-WB 301+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2014


MATCHLINE - SEE SHEET 000-K-2016 FOR CONTINUATION
MATCHLINE - SEE SHEET 000-K-2014 FOR CONTINUATION
N 26° 56' 56" W 122.70'
N 26° 56' 56" W 108.53'
N 26° 56' 27" W 155.44'
N 28° 14' 18" W 303.97'
N 83° 42' 50" W 173.63'
NH 165+00
NH 160+00
MB 310+00
MB 305+00
MAGOUN SQ. STATION
MB-EB 13B
MB-WB 15B
MB-WB 16
MB-WB 17
TELEPHONE MOUNTED TO NEW POLE
LOWELL ST
MATCH PATH TO EXISTING
AREA UNDER CONSTRUCTION
LIMITS OF MAPPING
ORIGINAL 2011 CONTOURS IN THIS AREA DO NOT REFLECT CURRENT CONDITIONS DUE TO ONGOING CONSTRUCTION AND ARE NOT SHOWN HEREON
N





CURVE MB-WB 15B				CURVE MB-EB 13B				CURVE MB-EB 14				CURVE MB-WB 16				CURVE MB-WB 17			
CS	300+31.86	Ls	131.29'	CS	300+36.82	Ls	130.77'	TS	309+42.95	Ls	60.00'	TS	305+56.42	Ls	40.00'	TS	310+62.86	Ls	40.00'
SC	301+63.15			SC	301+67.59			SC	310+02.95			SC	305+96.42			SC	311+02.86		
SC	301+63.15	Lc	90.48'	SC	301+67.59	Lc	490.70'	SC	310+02.95	Lc	464.55'	SC	305+96.42	Lc	122.46'	SC	311+02.86	Lc	41.66'
		R	3444.88'			R	3432.88'			R	10000.00'			R	1700.00'			R	1900.00'
		Ea	1.25"			Ea	1.25"			Ea	0.00"			Ea	2.00"			Ea	2.00"
		Eu	0.61"			Eu	0.66"			Eu	0.64"			Eu	1.77"			Eu	1.38"
CS	302+53.63	V	40 MPH	CS	306+58.29	V	40 MPH	CS	314+67.50	V	40 MPH	CS	307+18.88	V	40 MPH	CS	311+44.52	V	40 MPH
CS	302+53.63	Ls	129.16'	CS	306+58.29	Ls	129.22'	CS	314+67.50	Ls	60.00'	CS	307+18.88	Ls	40.00'	CS	311+44.52	Ls	40.00'
ST	303+82.79			ST	307+87.51			ST	315+27.50			ST	307+58.88			ST	311+84.52		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

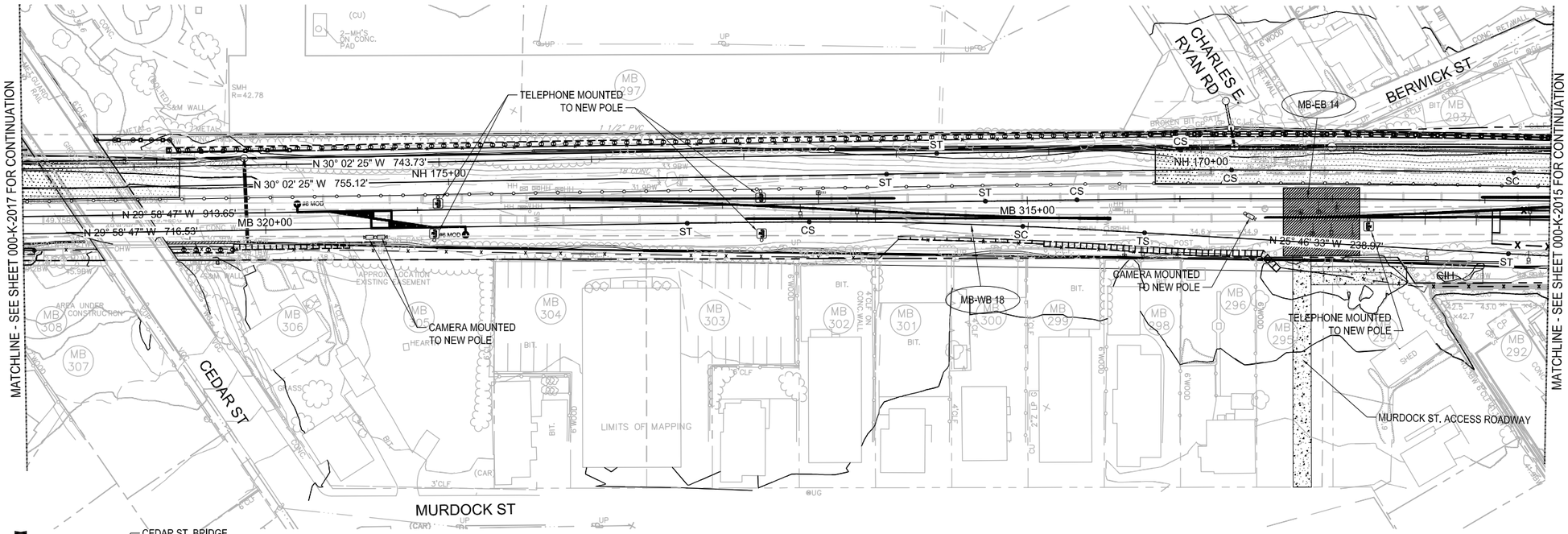
THE WALSH BARLETTA GRANITE
Joint Venture Team

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

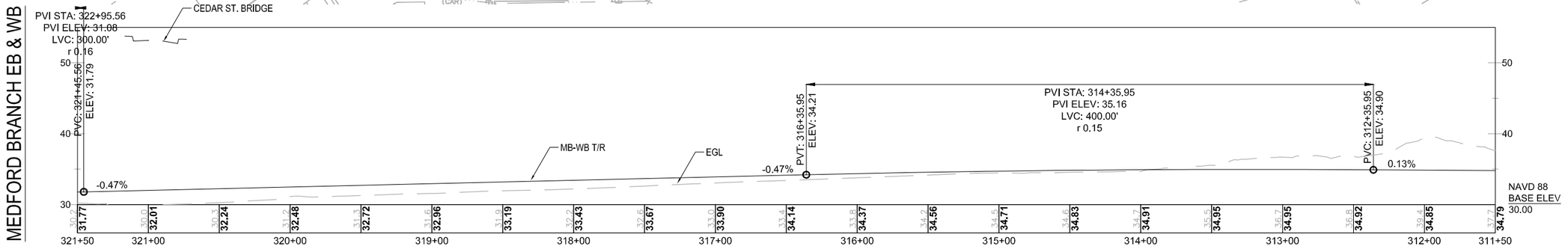
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 301+50 TO STA. MB-WB 311+50

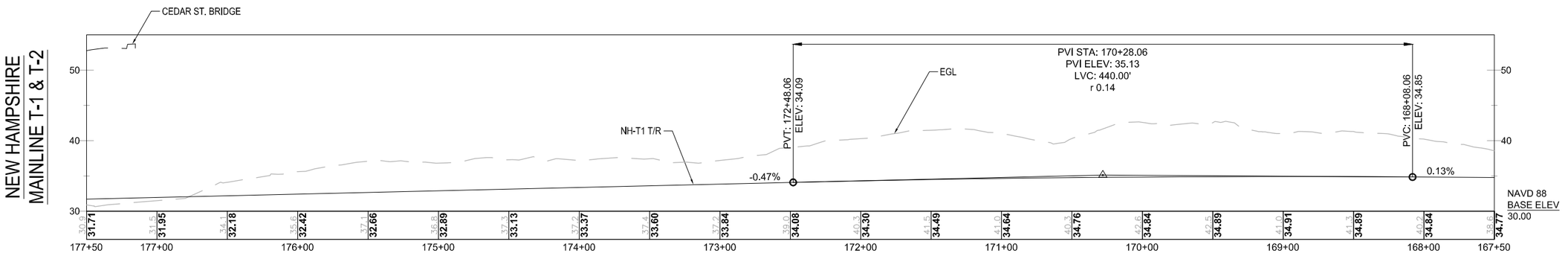
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2015


MATCHLINE - SEE SHEET 000-K-2017 FOR CONTINUATION
MATCHLINE - SEE SHEET 000-K-2015 FOR CONTINUATION
TELEPHONE MOUNTED TO NEW POLE
CAMERA MOUNTED TO NEW POLE
CAMERA MOUNTED TO NEW POLE
TELEPHONE MOUNTED TO NEW POLE
MB-WB 18
MB-EB 14
N 30° 02' 25" W 743.73'
N 30° 02' 25" W 755.12'
N 29° 58' 47" W 913.65'
N 29° 58' 47" W 716.53'
N 25° 46' 33" W 238.07'
NH 175+00
NH 170+00
MB 320+00
MB 315+00
CHARLES E RYAN RD
BERWICK ST
CEDAR ST
MURDOCK ST
MURDOCK ST. ACCESS ROADWAY
LIMITS OF MAPPING
AREA UNDER CONSTRUCTION
APPROX. LOCATION EXISTING EASEMENT
CEDAR ST. BRIDGE

MEDFORD BRANCH EB & WB



NEW HAMPSHIRE MAINLINE T-1 & T-2



CURVE MB-WB 18			
TS	314+23.48	Ls	80.00'
SC	315+03.48		
SC	315+03.48	Lc	140.11'
		R	3000.00'
		Ea	1.50"
		Eu	0.64"
CS	316+43.59	V	40 MPH
CS	316+43.59	Ls	80.00'
ST	317+23.59		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

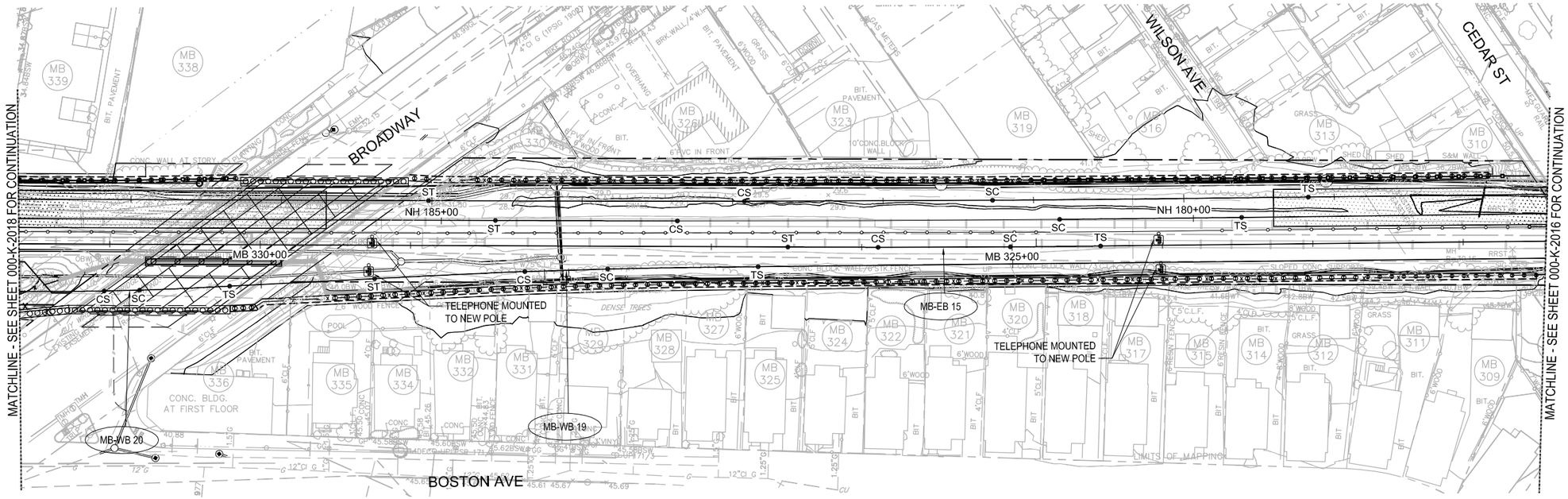
THE WALSH BARLETTA GRANITE
Joint Venture Team

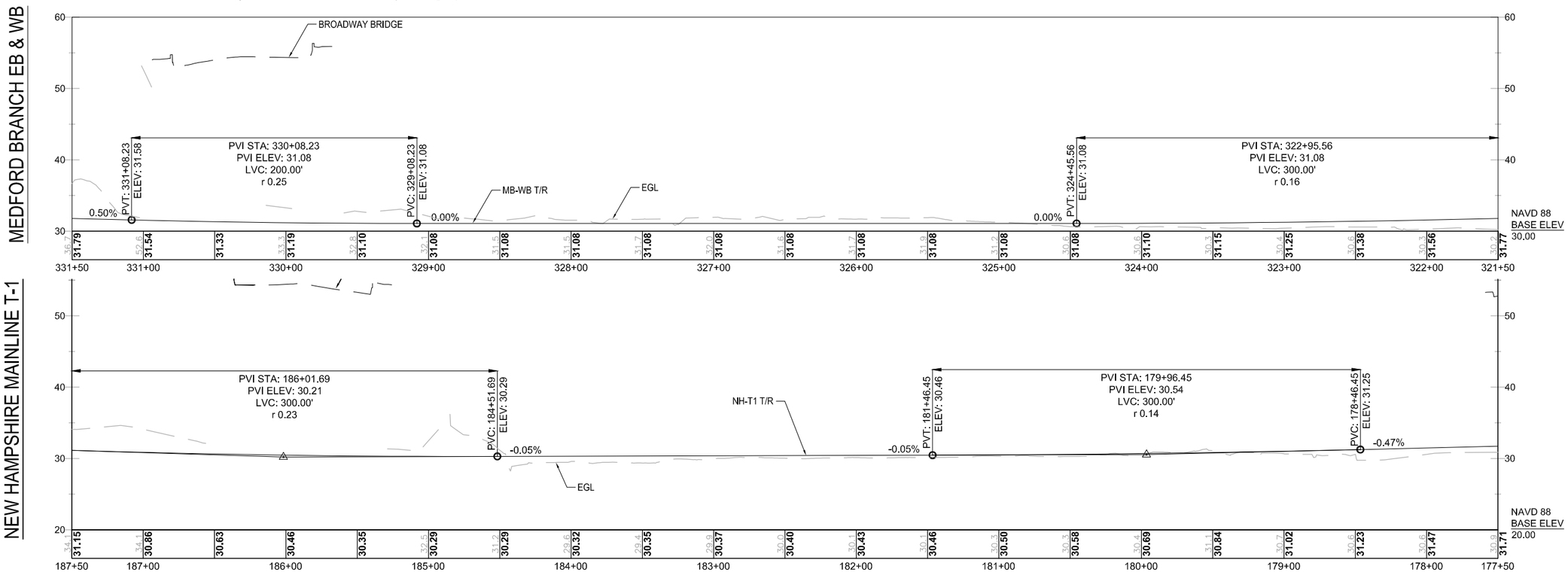
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 311+50 TO STA. MB-WB 321+50

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET 000-K-2016





CURVE MB-EB 15				CURVE MB-WB 19				CURVE MB-WB 20				CURVE NH-T1 13B				CURVE NH-T2 13B			
TS	324+41.16	Ls	60.00'	TS	326+69.30	Ls	100.00'	TS	330+20.98	Ls	60.00'	CS	156+51.25	Ls	130.00'	CS	156+34.48	Ls	151.13'
SC	325+01.16			SC	327+69.30			SC	330+80.98			SC	157+81.25			SC	157+85.61		
SC	325+01.16	Lc	87.95'	SC	327+69.30	Lc	55.15'	SC	330+80.98	Lc	23.43'	SC	157+81.25	Lc (Chord)	417.08'	SC	157+85.61	Lc (Chord)	434.62'
		R	10000.00'			R	3800.00'			R	1500.00'			Dc	1°41'03.12"			Dc	1°41'03.12"
		Ea	0.50"			Ea	1.75"			Ea	1.75"			Ea	2.75"			Ea	2.75"
		Eu	0.50"			Eu	0.39"			Eu	1.53"			Eu	2.23"			Eu	2.23"
CS	325+89.11	V	50 MPH	CS	328+24.45	V	45 MPH	CS	331+04.41	V	35 MPH	CS	161+98.59	V	65 MPH	CS	162+20.52	V	65 MPH
CS	325+89.11	Ls	60.00'	CS	328+24.45	Ls	100.00'	CS	331+04.41	Ls	60.00'	CS	161+98.59	Ls	280.00'	CS	162+20.52	Ls	245.97'
ST	326+49.11			ST	329+24.45			ST	331+64.41			ST	164+78.59			ST	164+66.49		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

4-180

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

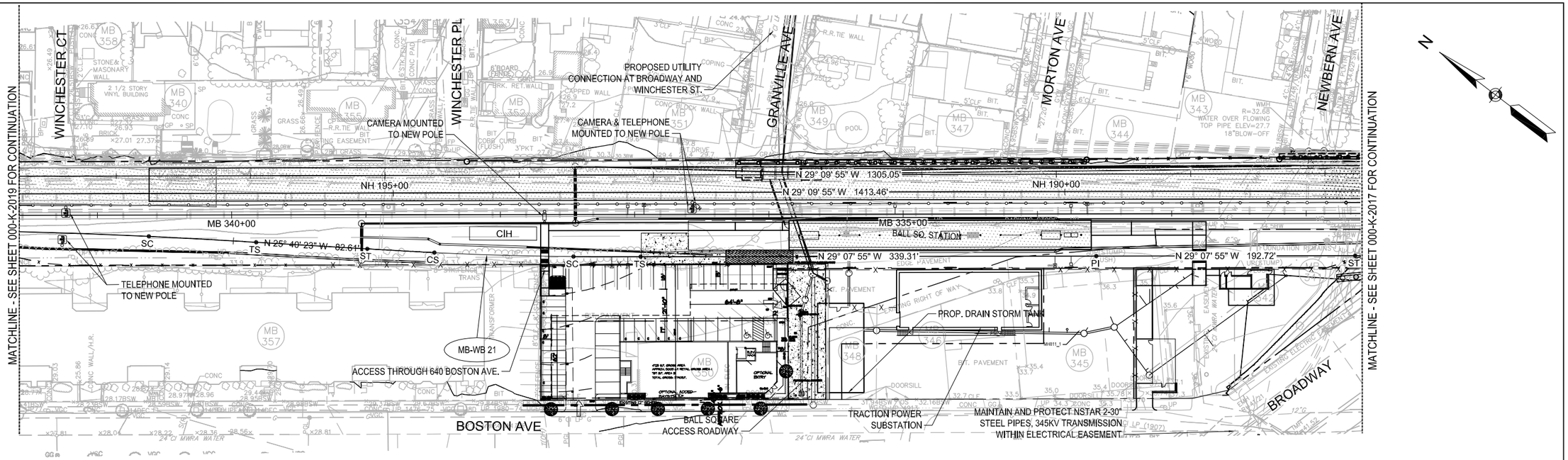
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

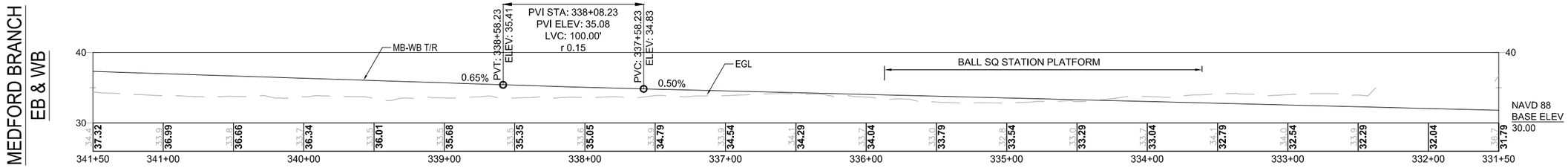
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

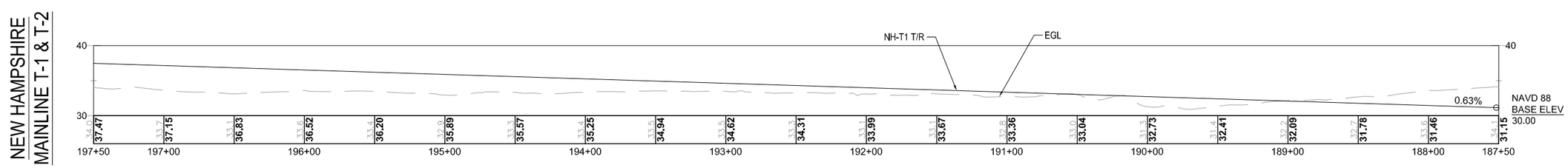
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 321+50 TO STA. MB-WB 331+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2017







CURVE MB-WB 21			
TS	336+96.45	Ls	50.00'
SC	337+46.45		
SC	337+46.45	Lc	103.63'
		R	2545.00'
		Ea	2.00"
		Eu	1.19"
CS	338+50.08	V	45 MPH
CS	338+50.08	Ls	50.00'
ST	339+00.08		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

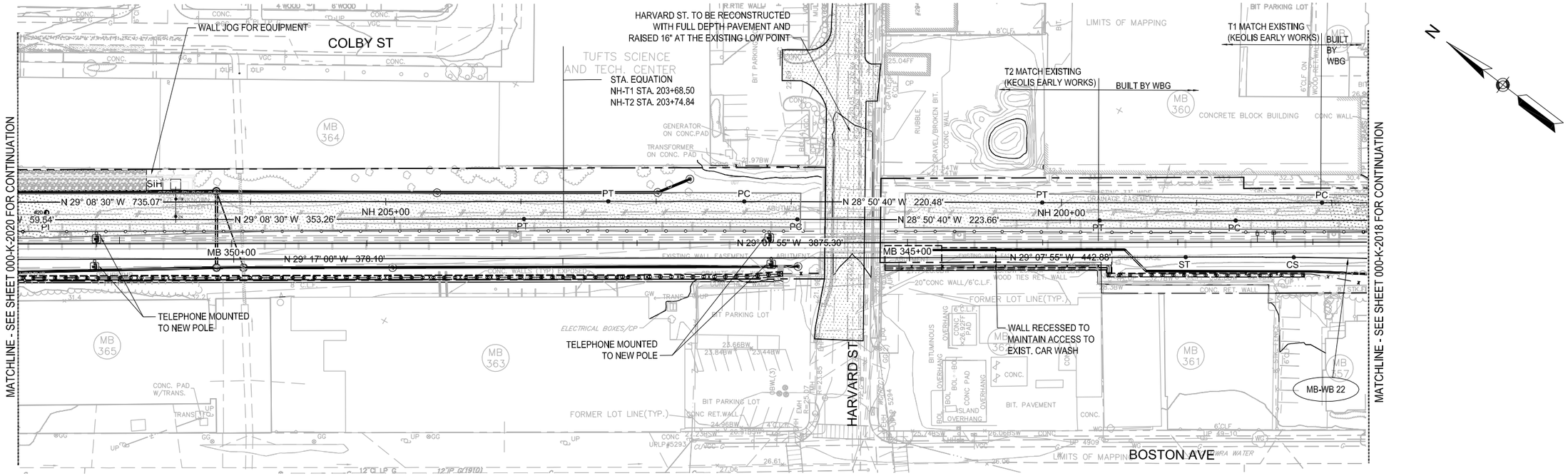
THE WALSH BARLETTA GRANITE
Joint Venture Team

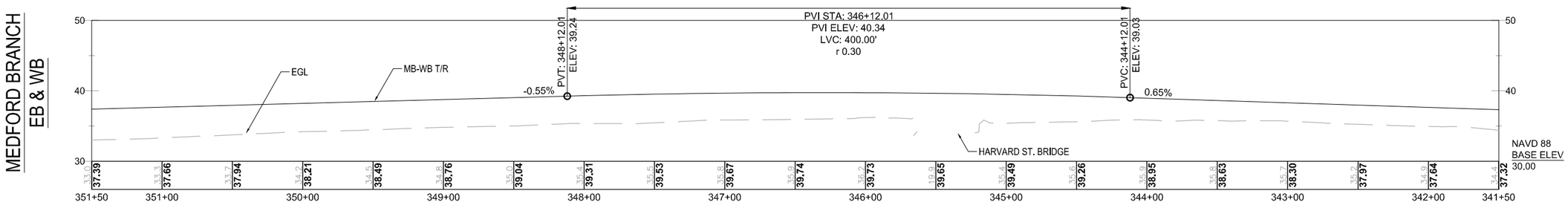
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

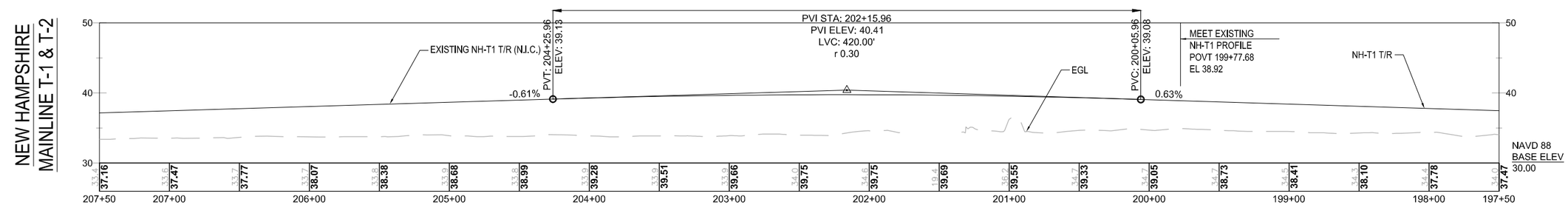
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 331+50 TO STA. MB-WB 341+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2018


MATCHLINE - SEE SHEET 000-K-2020 FOR CONTINUATION
COLBY ST
WALL JOG FOR EQUIPMENT
HARVARD ST. TO BE RECONSTRUCTED WITH FULL DEPTH PAVEMENT AND RAISED 16" AT THE EXISTING LOW POINT
TUFTS SCIENCE AND TECH. CENTER
STA. EQUATION
NH-T1 STA. 203+68.50
NH-T2 STA. 203+74.84
LIMITS OF MAPPING
T1 MATCH EXISTING (KEOLIS EARLY WORKS)
BUILT BY WBG
T2 MATCH EXISTING (KEOLIS EARLY WORKS)
BUILT BY WBG
CONCRETE BLOCK BUILDING
N 29° 08' 30" W 735.07'
59.54'
PI
N 29° 08' 30" W 353.26'
NH 205+00
PT
PC
N 28° 50' 40" W 220.48'
N 28° 50' 40" W 223.66'
NH 200+00
N 29° 07' 55" W 3875.39'
MB 350+00
N 29° 17' 00" W 378.10'
MB 345+00
N 29° 07' 55" W 442.88'
ST
CS
TELEPHONE MOUNTED TO NEW POLE
TELEPHONE MOUNTED TO NEW POLE
WALL RECESSED TO MAINTAIN ACCESS TO EXIST. CAR WASH
FORMER LOT LINE(TYP.)
BIT PARKING LOT
HARVARD ST
BOSTON AVE
MB-WB 22
MATCHLINE - SEE SHEET 000-K-2018 FOR CONTINUATION
N





CURVE NH-T1 14				CURVE NH-T2 14				CURVE NH-T1 15				CURVE NH-T2 15				CURVE MB-WB 22			
TS	166+01.29	Ls	160.00'	TS	165+75.02	Ls	226.23'	TS	179+17.20	Ls	210.00'	TS	179+67.85	Ls	121.00'	TS	339+83.01	Ls	80.00'
SC	167+61.29			SC	168+01.25			SC	181+27.20			SC	180+88.85			SC	340+63.01		
SC	167+61.29	Lc (Chord)	252.17'	SC	168+01.25	Lc (Chord)	185.23'	SC	181+27.20	Lc (Chord)	165.01'	SC	180+88.85	Lc (Chord)	254.21'	SC	340+63.01	Lc	152.53'
		Dc	0°45'00.00"			Dc	0°45'04.68"			Dc	0°14'00.00"			Dc	0°13'59.55"			R	3820.00'
		Ea	1.75"			Ea	1.75"			Ea	1.00"			Ea	1.00"			Ea	2.00"
		Eu	1.61"			Eu	1.61"			Eu	0.05"			Eu	0.04"			Eu	0.63"
CS	170+13.47	V	80 MPH	CS	169+86.49	V	80 MPH	CS	182+92.21	V	80 MPH	CS	183+43.06	V	80 MPH	CS	342+15.54	V	50 MPH
CS	170+13.47	Ls	160.00'	CS	169+86.49	Ls	226.24'	CS	182+92.21	Ls	210.00'	CS	183+43.06	Ls	121.00'	CS	342+15.54	Ls	80.00'
ST	171+73.47			ST	172+12.73			ST	185+02.21			ST	184+64.06			ST	342+95.54		

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

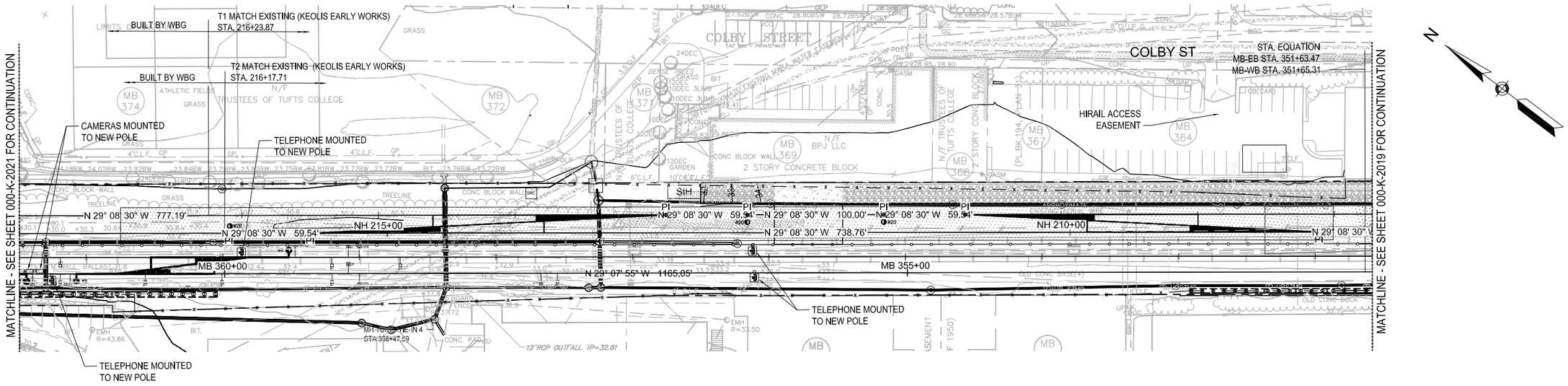
THE WALSH BARLETTA GRANITE
Joint Venture Team

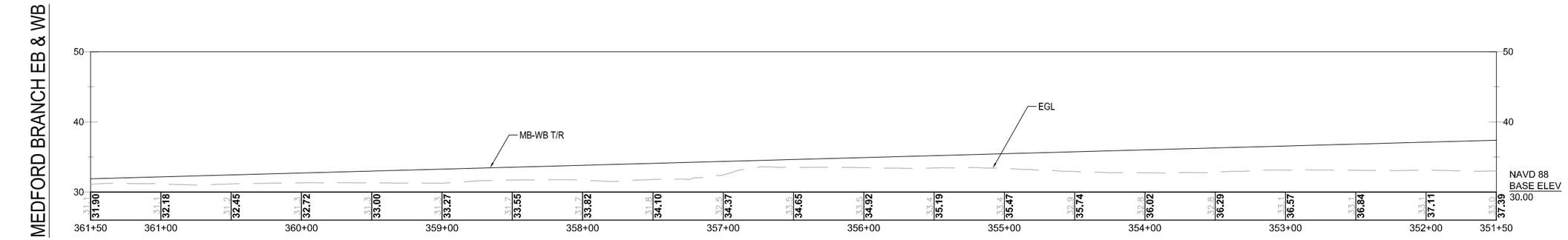
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

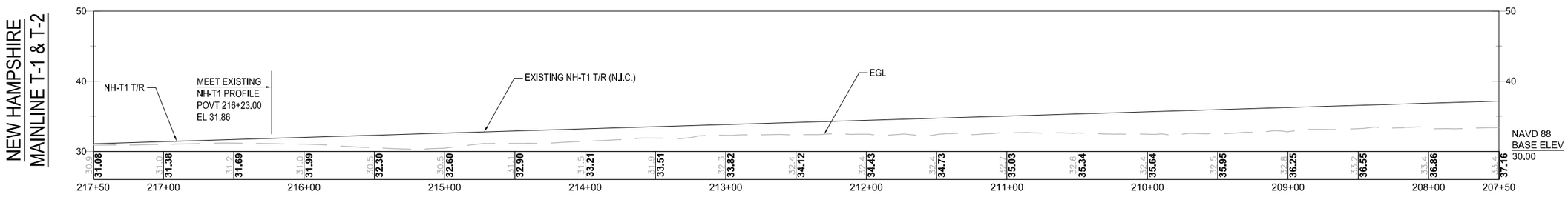
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 341+50 TO STA. MB-WB 351+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2019







NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

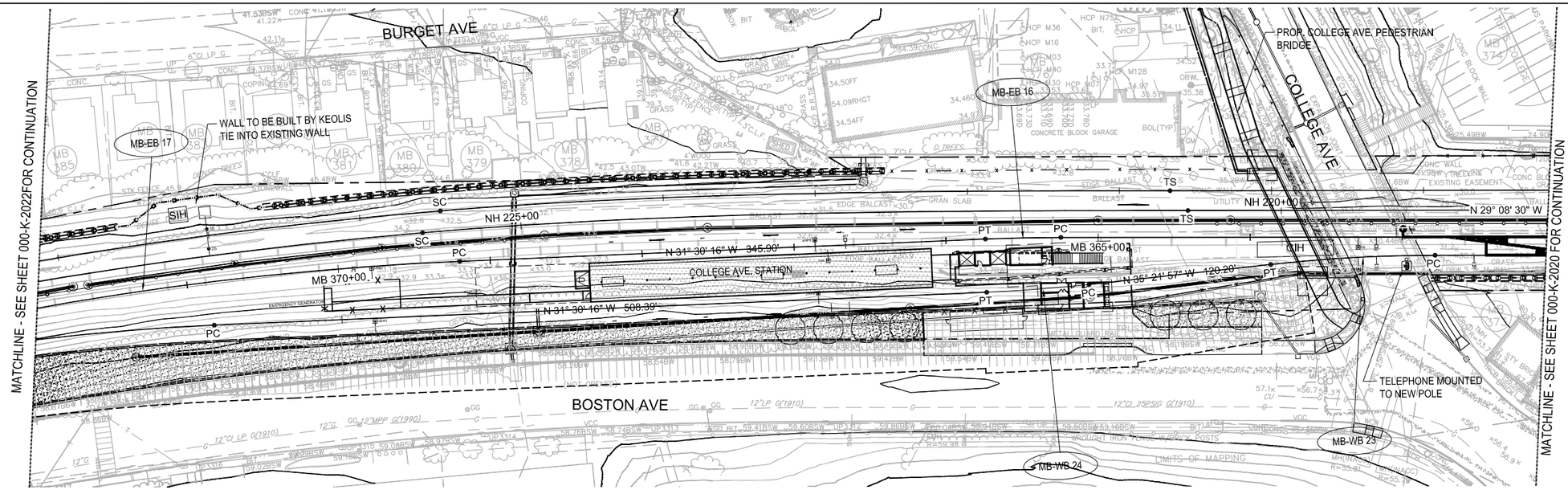
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

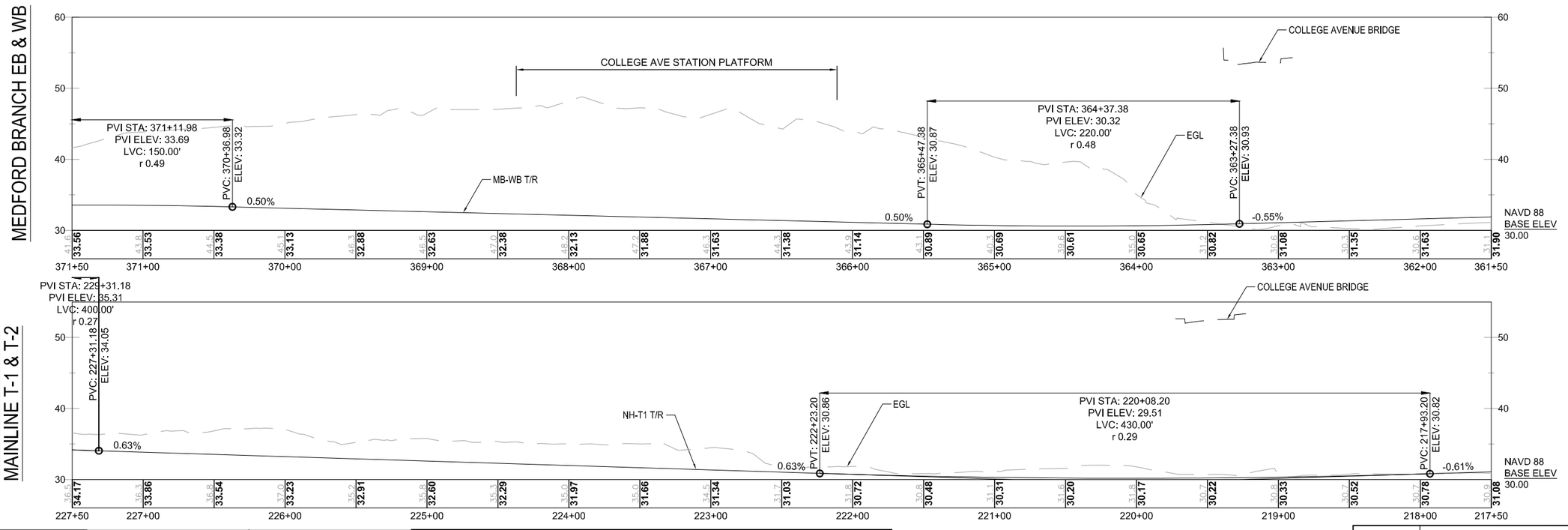
MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 351+50 TO STA. MB-WB 361+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2020



NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.



CURVE MB-EB 16				CURVE MB-WB 23				CURVE MB-WB 24				CURVE MB-EB 17				CURVE NH-T2 16				CURVE NH-T1 16			
PC	365+24.41	Ls	0.00'	PC	362+79.82	Ls	0.00'	PC	365+08.32	Ls	0.00'	PC	369+20.00	Ls	0.00'	PC	198+77.52	Ls	0.00'	TS	220+66.72	Ls	480.00'
																				SC	225+46.72		
PC	365+24.41	Lc	49.69'	PC	362+79.82	Lc	108.30'	PC	365+08.32	Lc	67.39'	PC	369+20.00	Lc	418.86'	SC	198+77.52	Lc (Chord)	100.72'	SC	225+46.72	Lc (Chord)	305.15'
		R	1200.00'			R	1000.00'			R	1000.00'			R	2064.30'			Dc	0°19'05.88"			Dc	1°53'05.50"
		Ea	0.00"			Ea	0.00"			Ea	0.00"			Ea	0.00"			Ea	0.00"			Ea	4.00"
		Eu	2.09"			Eu	2.51"			Eu	2.51"			Eu	1.21"			Eu	1.43"			Eu	2.47"
PT	365+74.10	V	25 MPH	PT	363+88.12	V	25 MPH	PT	365+75.71	V	25 MPH	PT	373+38.86	V	25 MPH	CS	199+78.24	V	80 MPH	CS	228+51.88	V	70 MPH
PT	365+74.10	Ls	0.00'	PT	363+88.12	Ls	0.00'	PT	365+75.71	Ls	0.00'	PT	373+38.86	Ls	0.00'	PT	199+78.24	Ls	0.00'	CS	228+51.88		
																				ST	233+31.88	Ls	480.00'

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

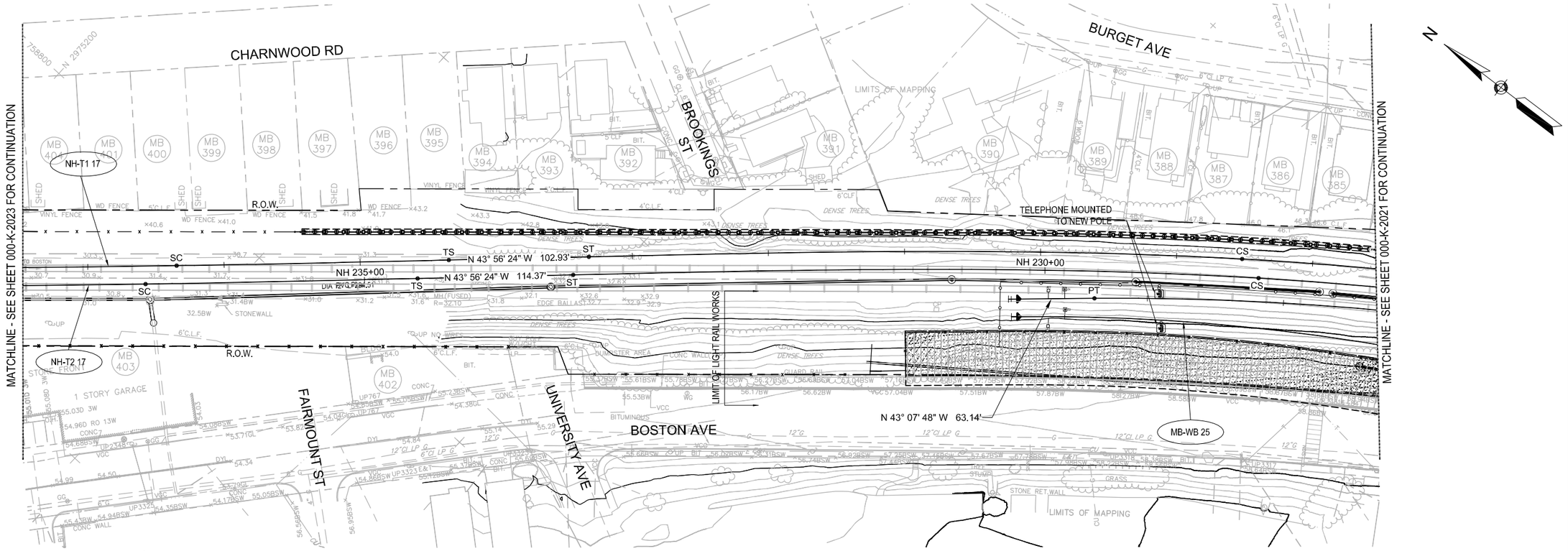
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

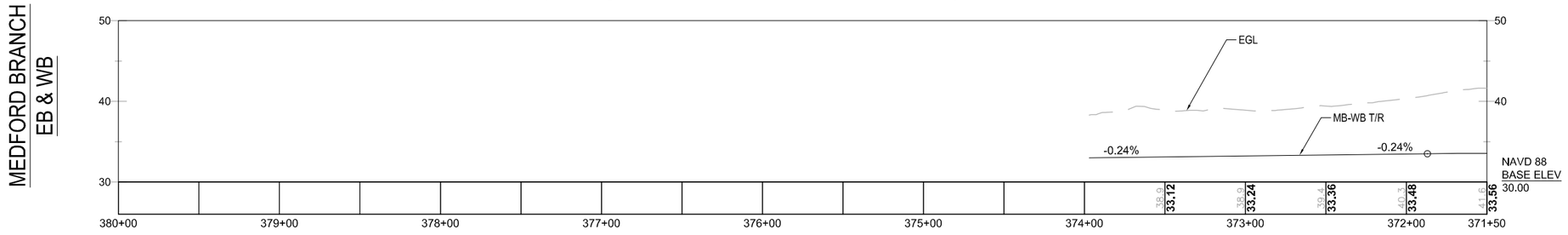
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

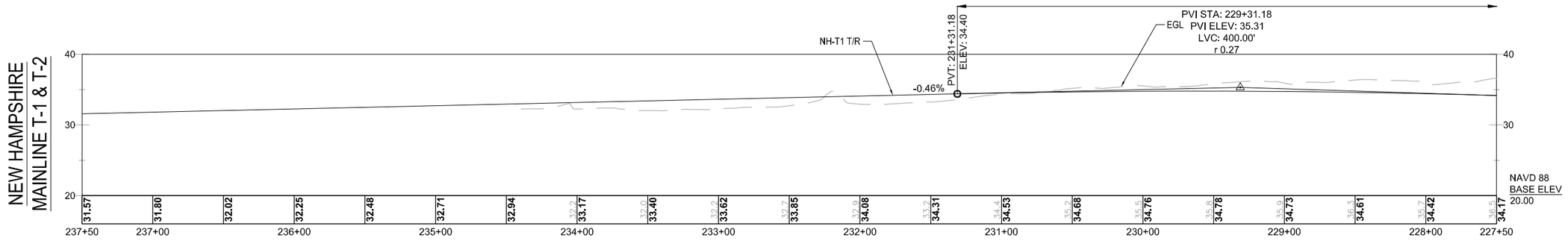
MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 361+50 TO STA. MB-WB 371+50

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2021







CURVE NH-T2 17				CURVE NH-T1 17				CURVE MB-WB 25			
TS	220+61.27	Ls	503.60'	TS	234+34.81	Ls	200.00'	PC	370+84.10	Ls	0.00'
SC	225+64.87			SC	236+34.81						
SC	225+64.87	Lc (Chord)	278.10'	SC	236+34.81	Lc (Chord)	146.47'	PC	370+84.10	Lc	312.45'
		Dc	1°53'35.40"			Dc	0°24'34.56"			R	1500.00'
		Ea	4.00"			Ea	1.00"			Ea	0.00"
		Eu	2.49"			Eu	0.41"			Eu	1.07"
CS	228+42.99	V	70 MPH	CS	237+81.28	V	70 MPH	PT	373+96.55	V	20 MPH
CS	228+42.99	Ls	503.60'	CS	237+81.28	Ls	200.00'	PT	373+96.55	Ls	0.00'
ST	233+46.59			ST	239+81.28						

NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

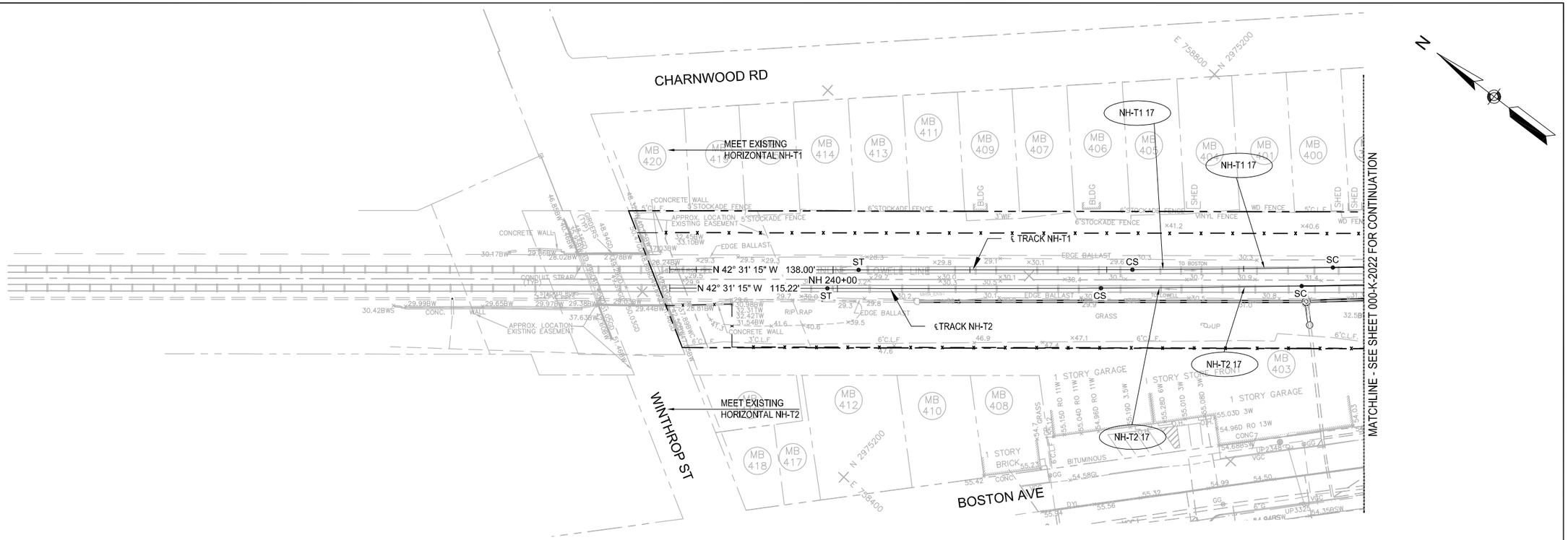
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

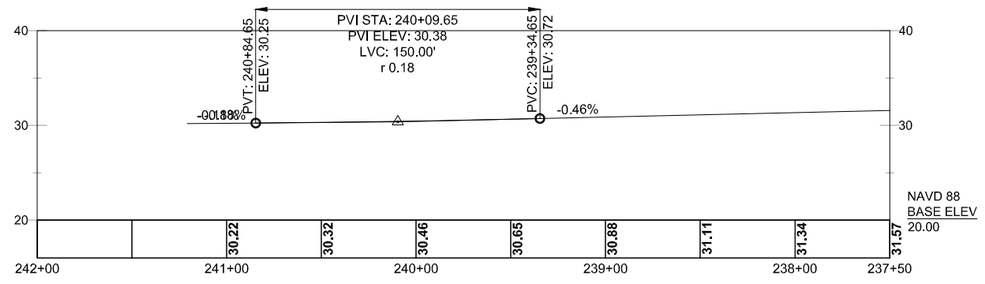
MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 371+50 TO STA. MB-WB 380+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2022



CURVE NH-T2 18			
TS	234+60.96	Ls	199.87'
SC	236+60.83		
SC	236+60.83	Lc (Chord)	146.60'
		Dc	0°24'34.56"
		Ea	1.00"
		Eu	0.41"
CS	238+07.43	V	70 MPH
CS	238+07.43	Ls	199.87'
ST	240+07.30		

NEW HAMPSHIRE MAINLINE T-1 & T-2



NOTES:

1. MB-WB VERTICAL PROFILE EQUALS MB-EB VERTICAL PROFILE, UNLESS OTHERWISE NOTED.
2. NH-T1 VERTICAL PROFILE EQUALS NH-T2 VERTICAL PROFILE, UNLESS OTHERWISE NOTED.

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

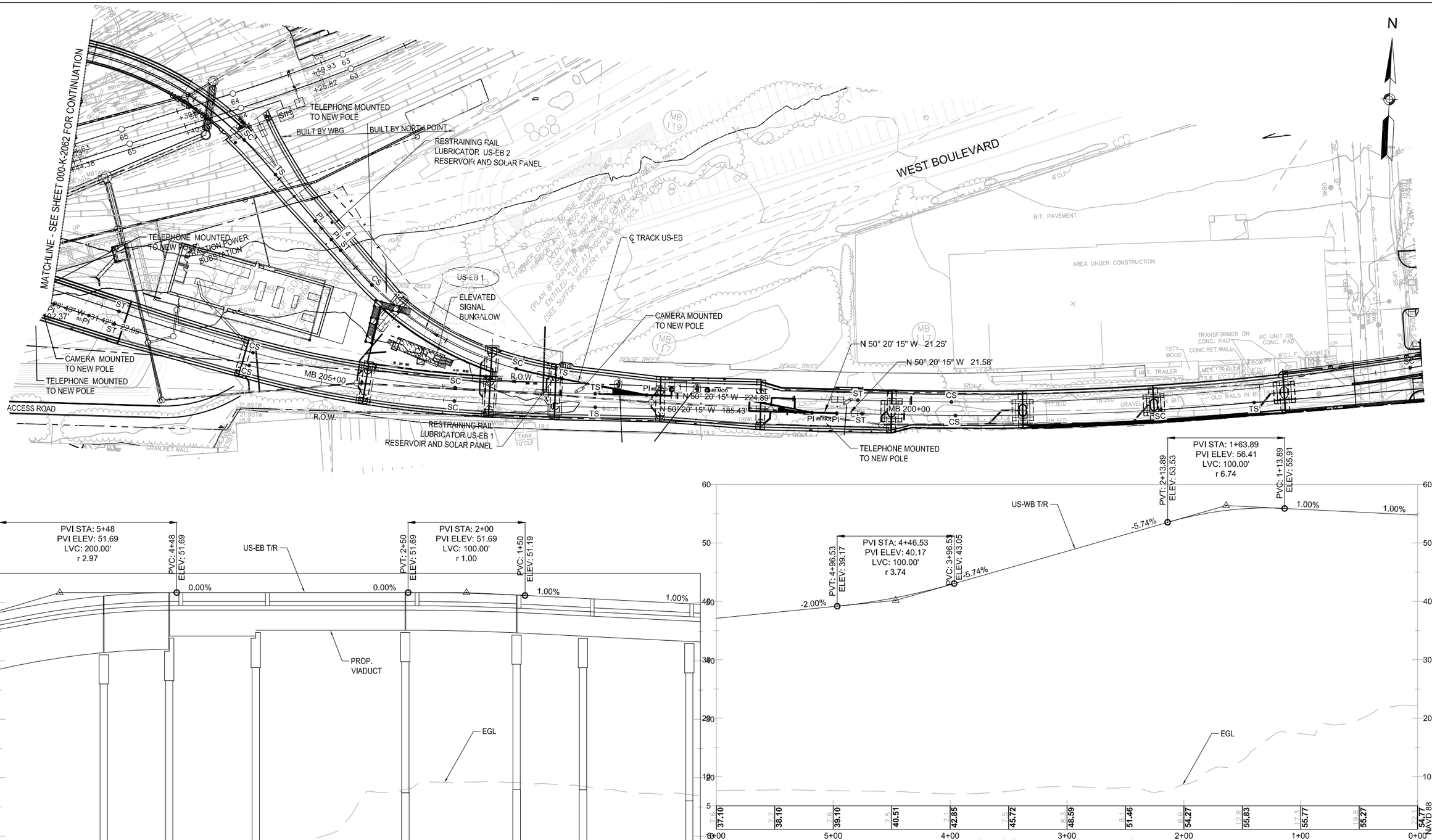
THE WALSH BARLETTA GRANITE
Joint Venture Team

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD BRANCH & NH MAINLINE CORRIDOR PLAN
STA. MB-WB 380+00 TO STA. MB-WB 385+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2023



UNION SQUARE EB BRANCH

UNION SQUARE WB BRANCH

CURVE US-EB 1			
TS	0+95.10	Ls	40.00'
SC	1+35.10		
SC	1+35.10	Lc	144.32'
		R	275.00'
		Ea	1.00''
		Eu	0.46''
CS	2+79.42	V	10 MPH
CS	2+79.42	Ls	40.00'
ST	3+19.42		

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

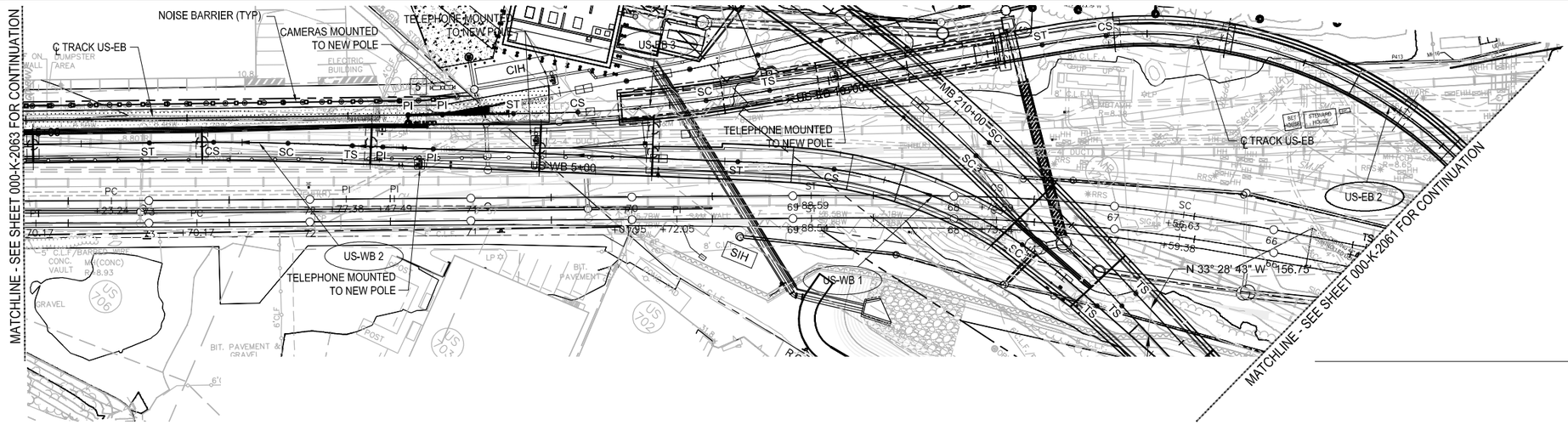
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

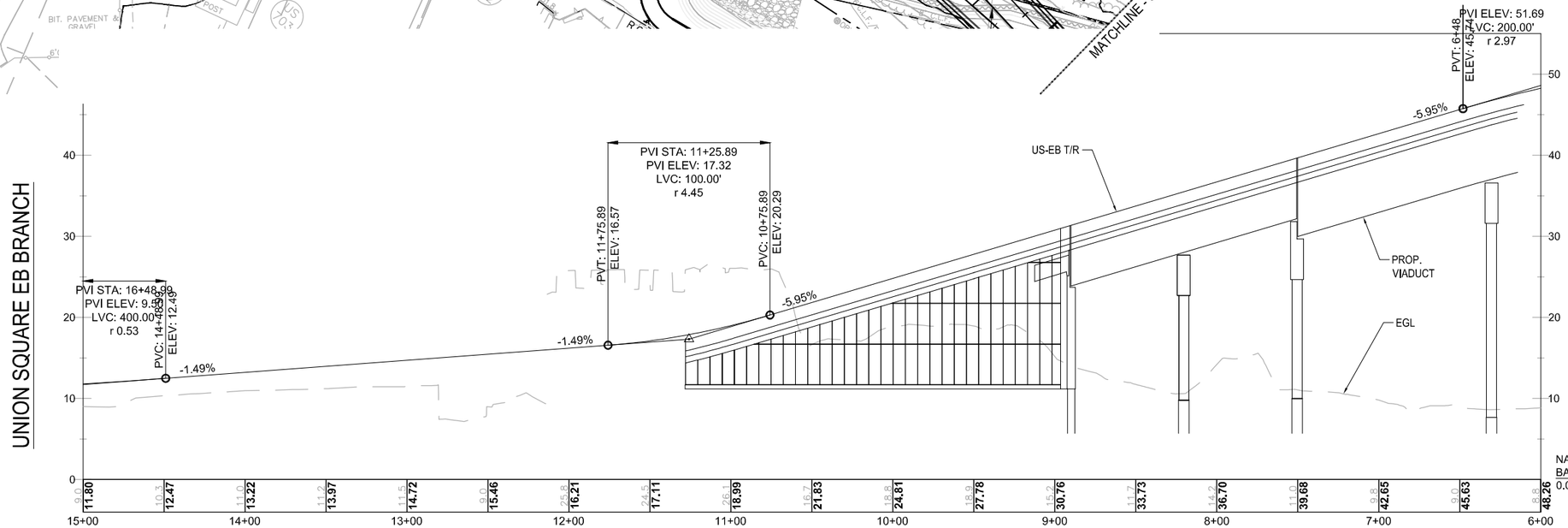
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

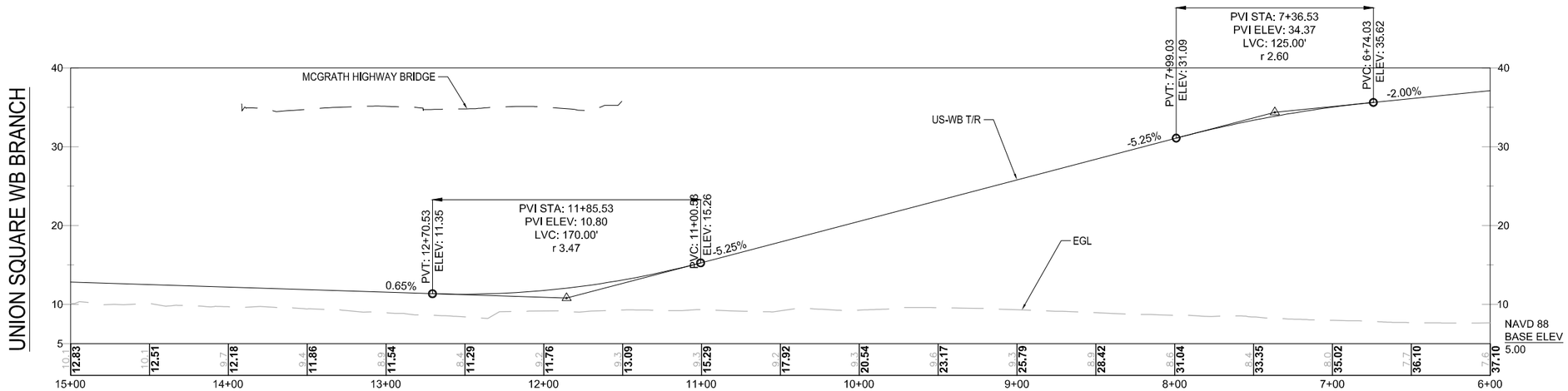
UNION SQUARE BRANCH CORRIDOR PLAN
STA. US-EB 0+00 TO STA. US-EB 6+00

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2061







CURVE US-EB 2				CURVE US-EB 3			
TS	4+04.93	Ls	40.00'	TS	10+37.18	Ls	40.00'
SC	4+44.93			SC	10+77.18		
SC	4+44.93	Lc	380.63'	SC	10+77.18	Lc	80.00'
		R	275.00'			R	787.59'
		Ea	1.00"			Ea	0.50"
		Eu	0.46"			Eu	0.01"
CS	8+25.56	V	10 MPH	CS	11+57.18	V	10 MPH
CS	8+25.56	Ls	40.00'	CS	11+57.18	Ls	40.00'
ST	8+65.56			ST	11+97.18		
CURVE US-WB 1				CURVE US-WB 2			
TS	1+44.87	Ls	60.00'	TS	6+31.51	Ls	40.00'
SC	2+04.87			SC	6+71.51		
SC	2+04.87	Lc	127.00'	SC	6+71.51	Lc	46.21'
		R	275.00'			R	1567.17'
		Ea	1.00"			Ea	0.50"
		Eu	0.46"			Eu	0.52"
CS	3+31.87	V	10 MPH	CS	7+17.72	V	20 MPH
CS	3+31.87	Ls	60.00'	CS	7+17.72	Ls	40.00'
ST	3+91.87			ST	7+57.72		

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

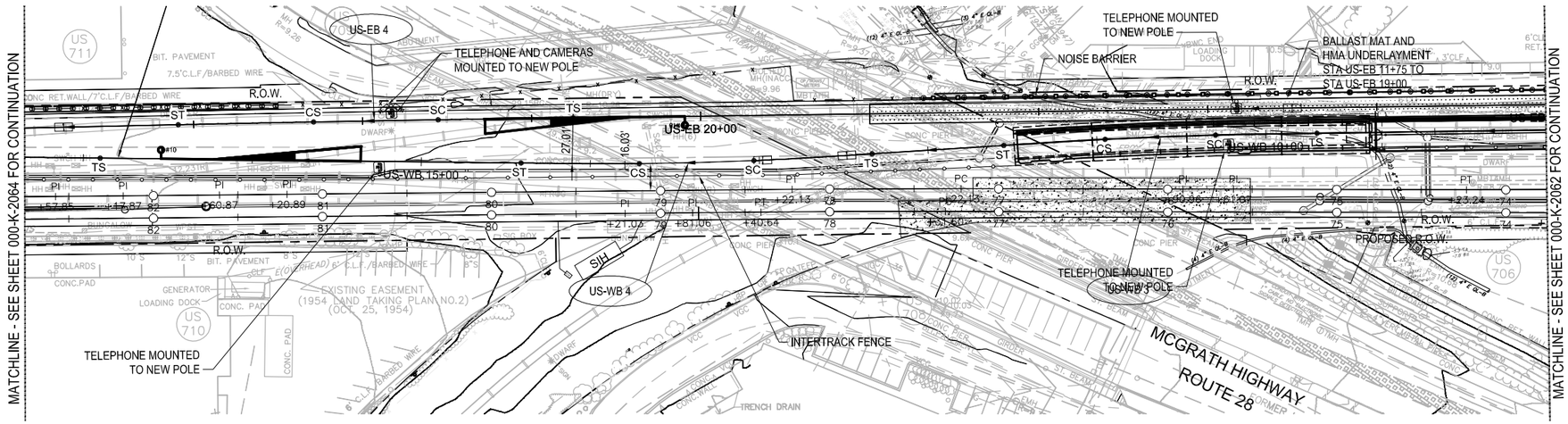
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

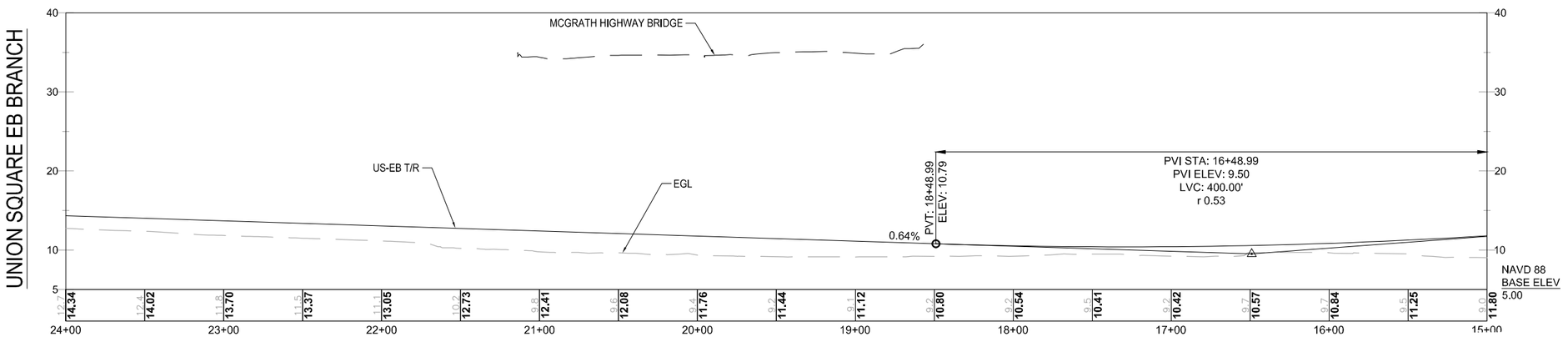
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

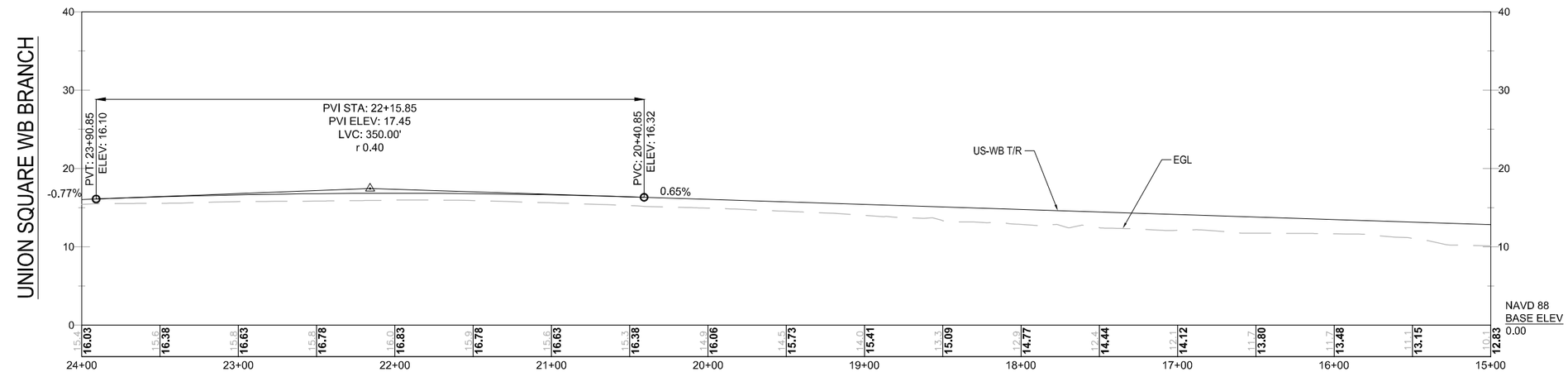
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

UNION SQUARE BRANCH CORRIDOR PLAN
STA. US-EB 6+00 TO STA. US-EB 15+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2062







CURVE US-EB 4				RVE US-WB 3				CURVE US-WB 4			
TS	20+75.28	Ls	80.00'	TS	9+69.65	Ls	60.00'	TS	12+33.18	Ls	70.00'
SC	21+55.28			SC	10+29.65			SC	13+03.18		
SC	21+55.28	Lc	73.76'	SC	10+29.65	Lc	65.45'	SC	13+03.18	Lc	67.79'
		R	20000.00'			R	2500.00'			R	1829.82'
		Ea	0.00"			Ea	1.00"			Ea	1.00"
		Eu	0.18"			Eu	0.44"			Eu	0.97"
CS	22+29.04	V	30 MPH	CS	10+95.10	V	30 MPH	CS	13+70.97	V	30 MPH
CS	22+29.04	Ls	80.00'	CS	10+95.10	Ls	60.00'	CS	13+70.97	Ls	70.00'
ST	23+09.04			ST	11+55.10			ST	14+40.97		

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

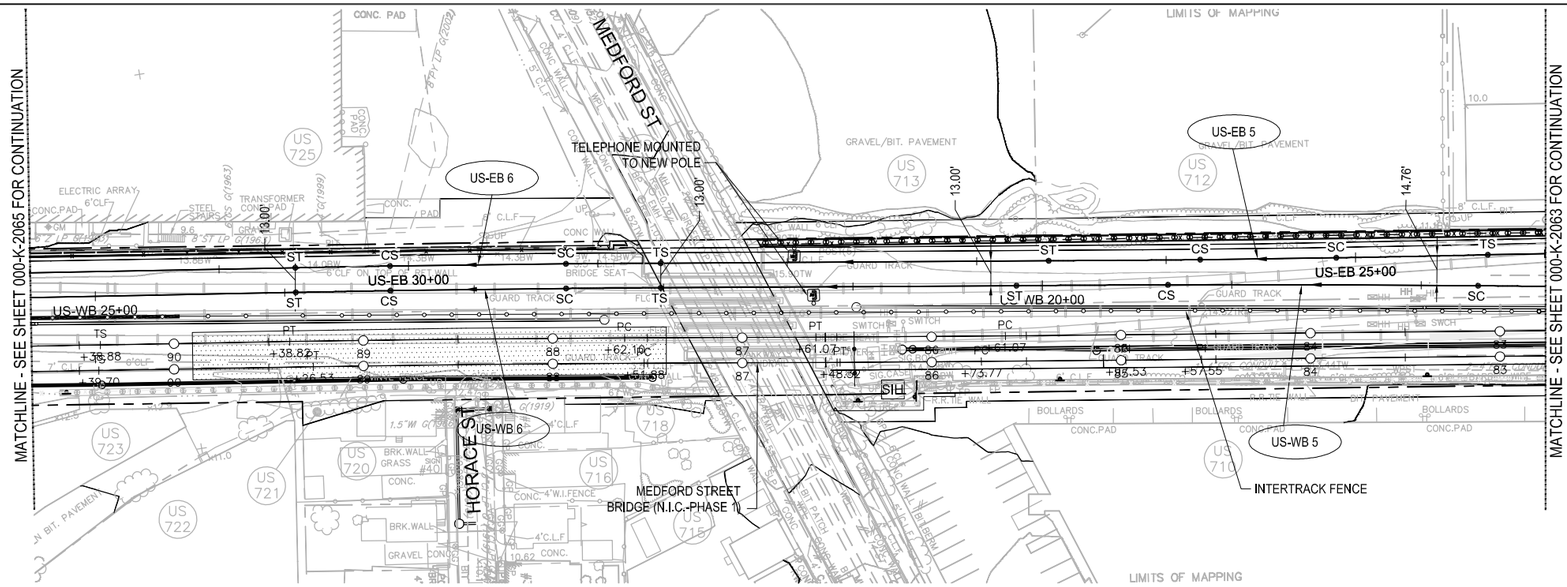
THE WALSH BARLETTA GRANITE
Joint Venture Team

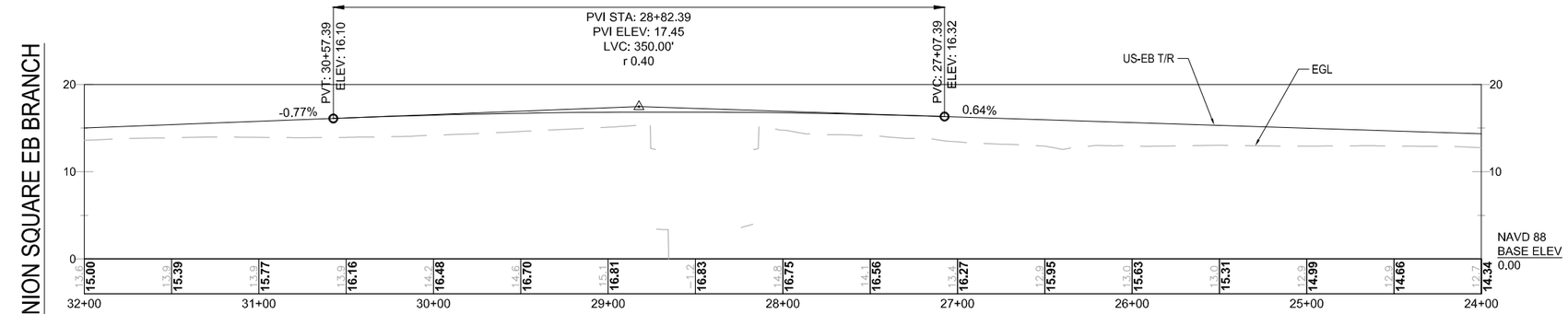
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

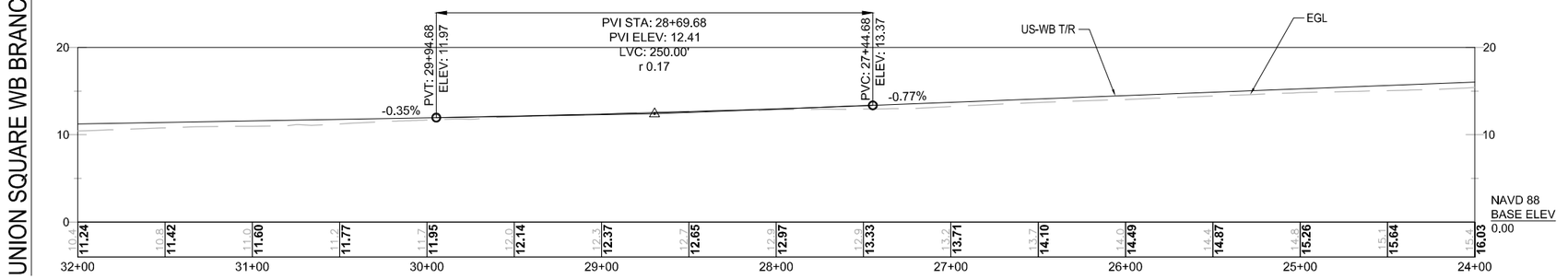
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

UNION SQUARE BRANCH CORRIDOR PLAN
STA. US-EB 15+00 TO STA. US-EB 24+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2063







CURVE US-WB 5				CURVE US-EB 5				CURVE US-EB 6				CURVE US-WB 6			
TS	16+89.97	Ls	80.00'	TS	24+30.16	Ls	80.00'	TS	28+66.83	Ls	50.00'	TS	22+01.40	Ls	50.00'
SC	17+69.97			SC	25+10.16			SC	29+16.83			SC	22+51.40		
SC	17+69.97	Lc	163.72'	SC	25+10.16	Lc	71.86'	SC	29+16.83	Lc	92.91'	SC	22+51.40	Lc	92.74'
		R	13833.65'			R	10000.00'			R	10880.00'			R	10867.00'
		Ea	0.50"			Ea	0.75"			Ea	0.75"			Ea	0.75"
		Eu	0.22"			Eu	0.25"			Eu	0.17"			Eu	0.17"
CS	19+33.69	V	50 MPH	CS	25+82.02	V	50 MPH	CS	30+09.74	V	50 MPH	CS	23+44.14	V	50 MPH
CS	19+33.69	Ls	80.00'	CS	25+82.02	Ls	80.00'	CS	30+09.74	Ls	50.00'	CS	23+44.14	Ls	50.00'
ST	20+13.69			ST	26+62.02			ST	30+59.74			ST	23+94.14		

0 40 100 200

SCALE: 1" = 40'

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

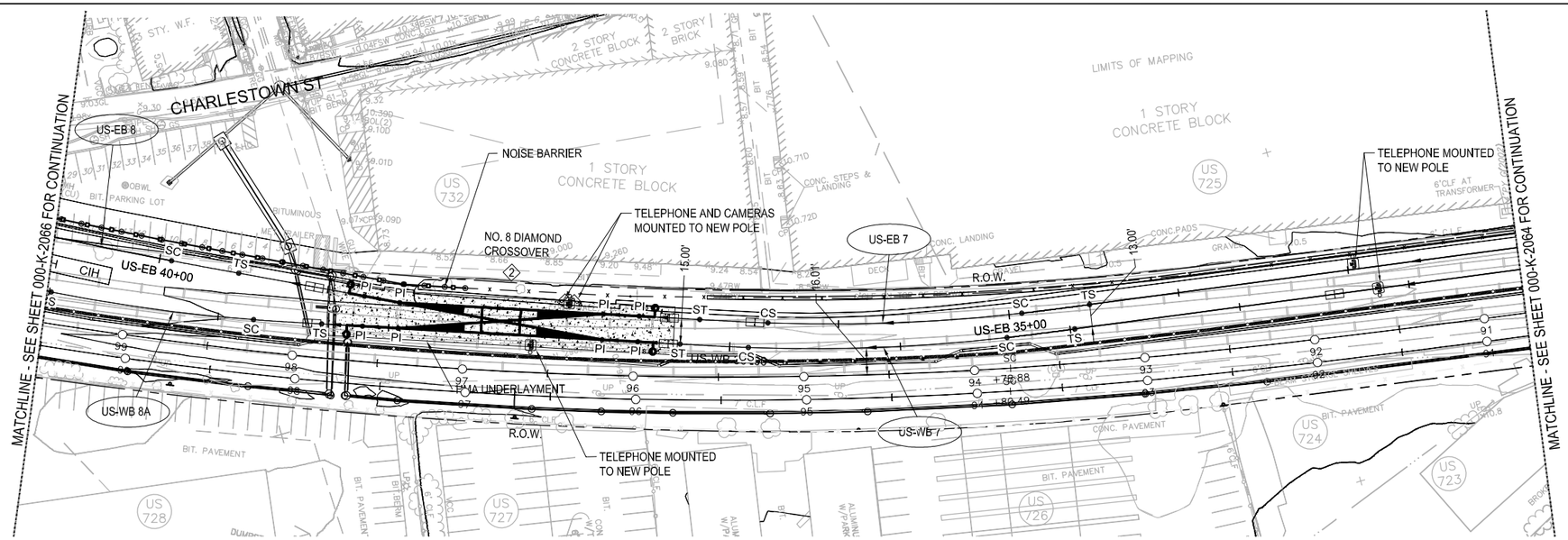
THE WALSH BARLETTA GRANITE
Joint Venture Team

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

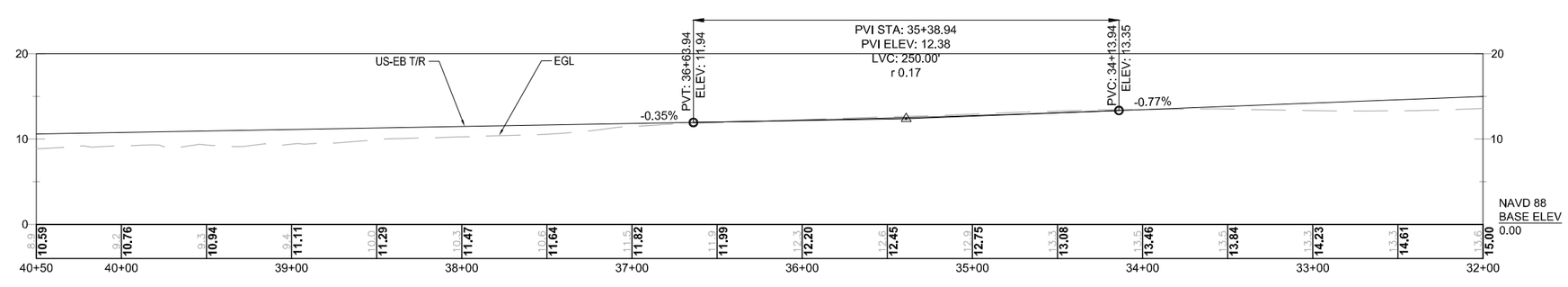
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

UNION SQUARE BRANCH CORRIDOR PLAN
STA. US-EB 24+00 TO STA. US-EB 32+00

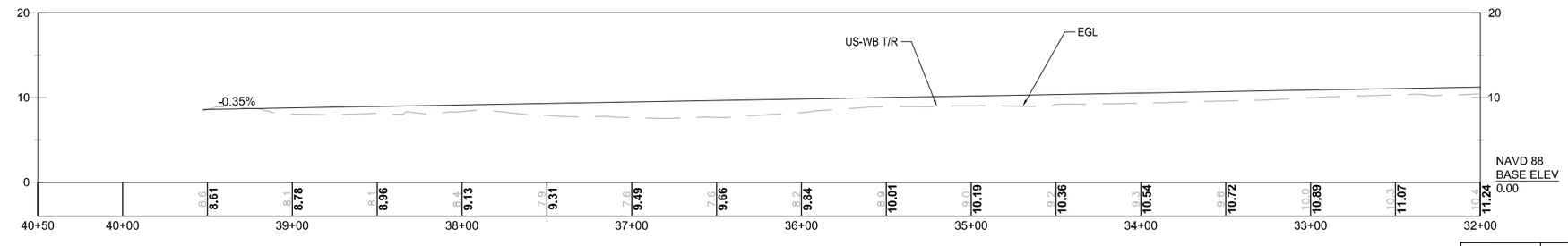
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2064



UNION SQUARE EB BRANCH



UNION SQUARE WB BRANCH



CURVE US-EB 7				CURVE US-WB 7				CURVE US-EB 8				CURVE US-WB 8A			
TS	34+52.54	Ls	40.00'	TS	27+97.40	Ls	40.00'	TS	39+53.03	Ls	40.00'	TS	32+39.21	Ls	40.00'
SC	34+92.54			SC	28+37.40			SC	39+93.03			SC	32+79.21		
SC	34+92.54	Lc	148.82'	SC	28+37.40	Lc	151.66'	SC	39+93.03	Lc	269.72'	SC	32+79.21	Lc	119.59'
		R	1000.00'			R	1015.00'			R	3000.00'			R	1000.67'
		Ea	1.00"			Ea	1.00"			Ea	0.00"			Ea	1.00"
		Eu	0.60"			Eu	0.58"			Eu	0.53"			Eu	0.60"
CS	36+41.36	V	20 MPH	CS	29+89.06	V	20 MPH	CS	42+62.75	V	20 MPH	CS	33+98.80	V	20 MPH
CS	36+41.36	Ls	40.00'	CS	29+89.06	Ls	40.00'	CS	42+62.75	Ls	40.00'	CS	33+98.80	Ls	41.00'
ST	36+81.36			ST	30+29.06			ST	43+02.75			SC	34+39.80		

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

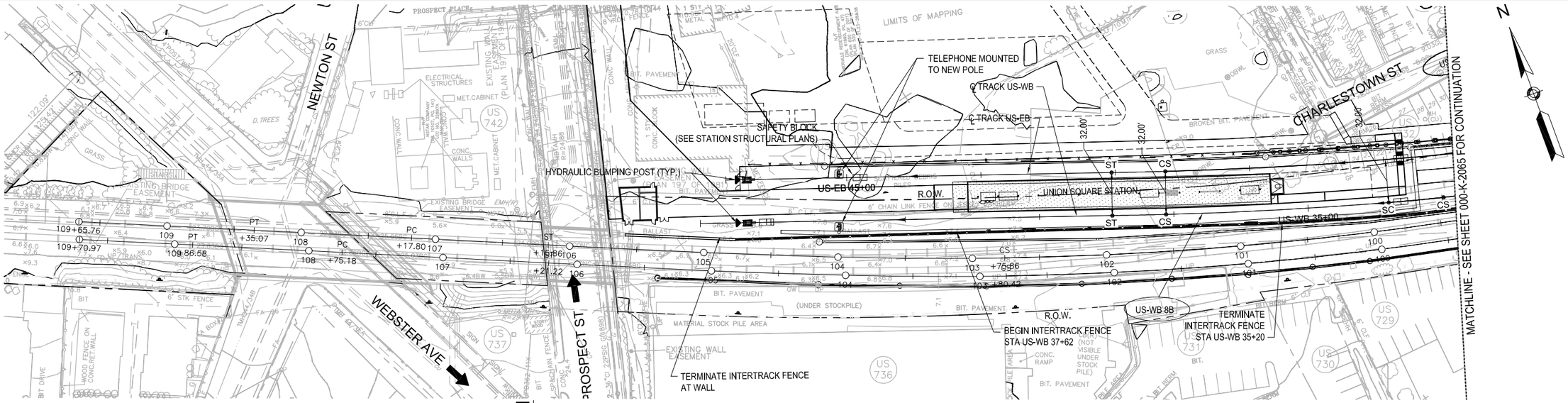
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

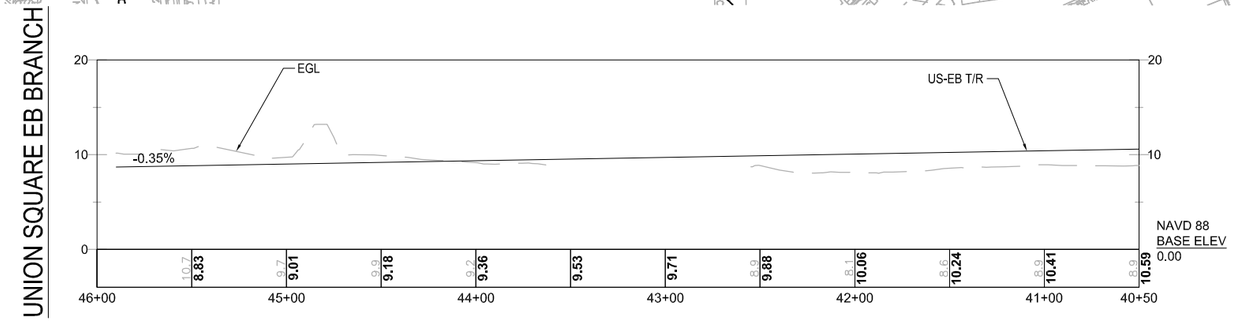
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

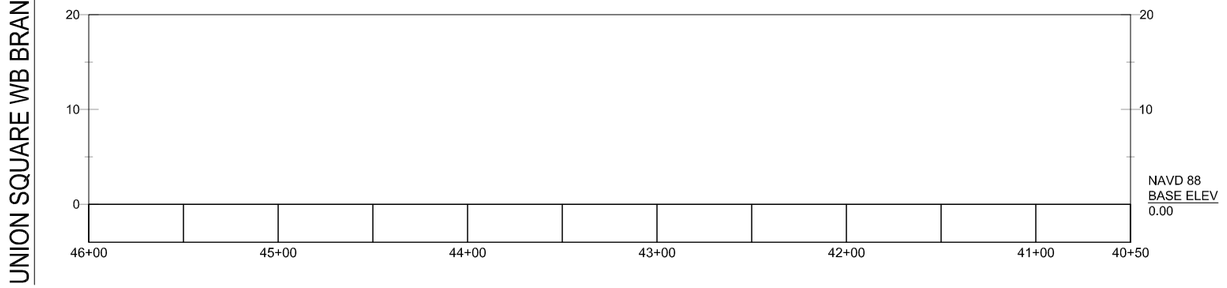
UNION SQUARE BRANCH
CORRIDOR PLAN
STA. US-EB 32+00 TO STA. US-EB 40+50

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **000-K-2065**







CURVE US-WB 8B			
CS	33+98.80	Ls	41.00'
SC	34+39.80		
SC	34+39.80	Lc	165.98'
		R	3032.00'
		Ea	0.00''
		Eu	0.53''
CS	36+05.78	V	20 MPH
CS	36+05.78	Ls	40.00'
ST	36+45.78		

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

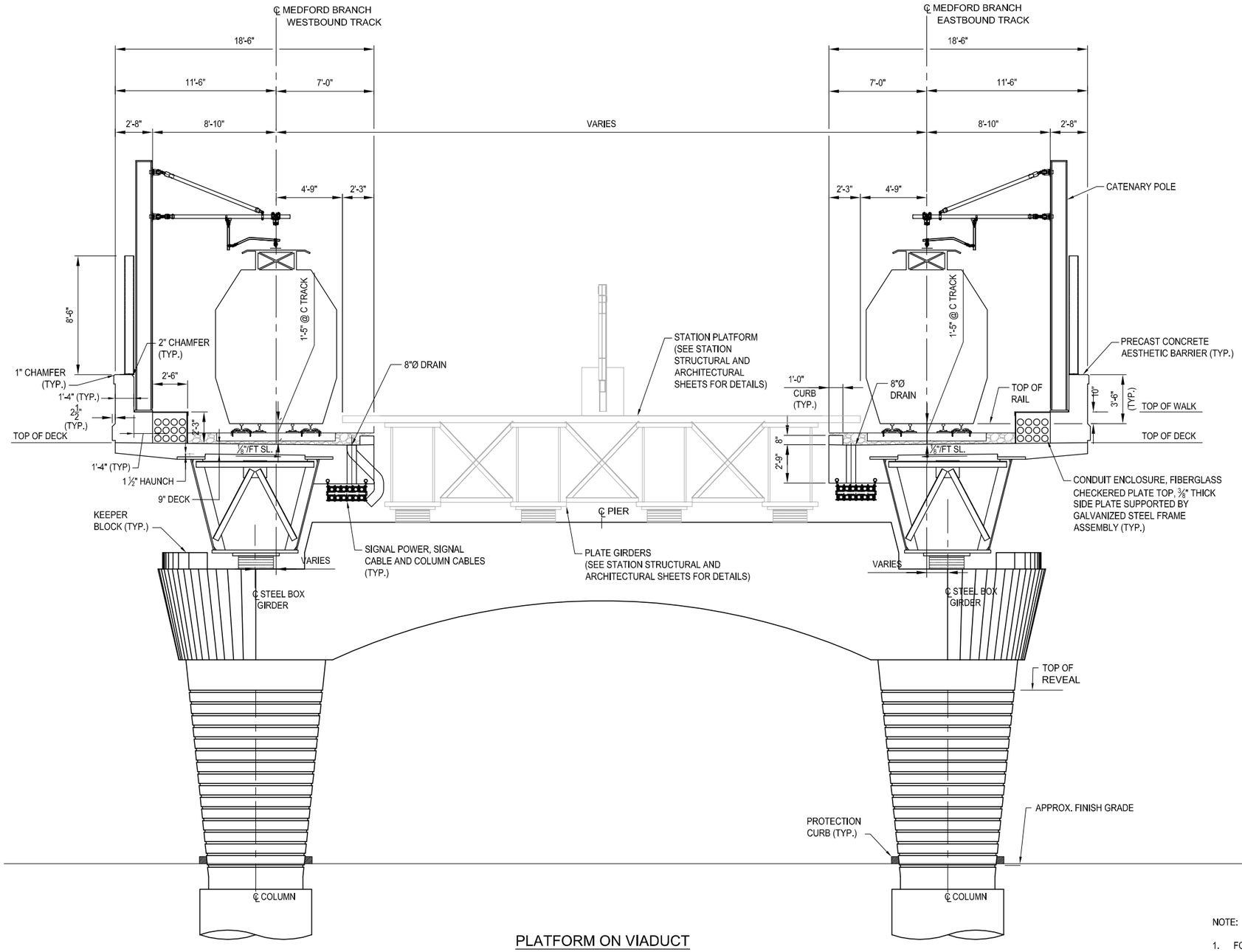
THE WALSH BARLETTA GRANITE
Joint Venture Team

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

UNION SQUARE BRANCH CORRIDOR PLAN
STA. US-EB 40+50 TO STA. US-EB 46+00

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-K-2066



PLATFORM ON VIADUCT

NOTE:

1. FOR VIADUCT TYPICAL SECTIONS SEE VIADUCT PLANS

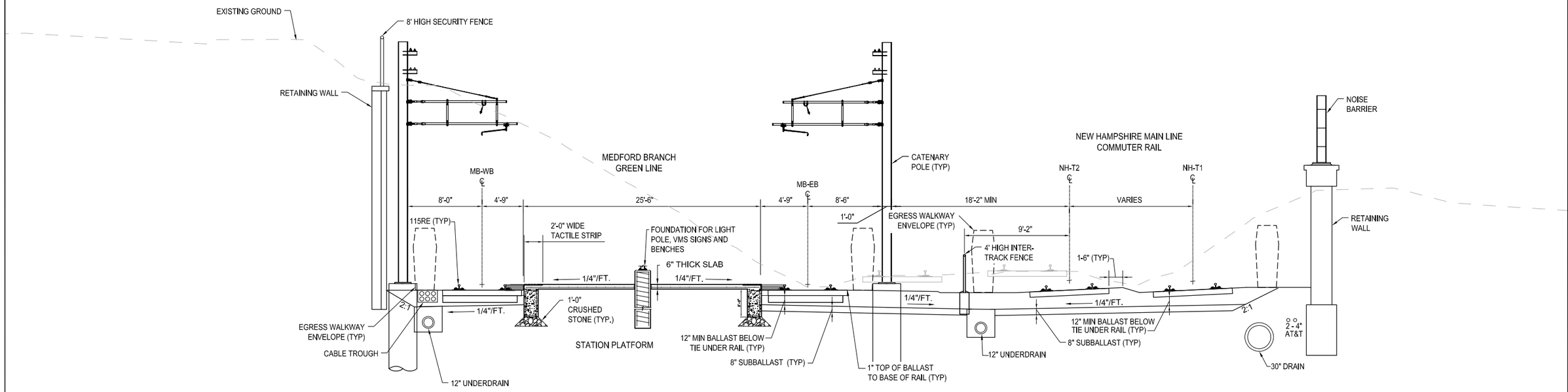
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

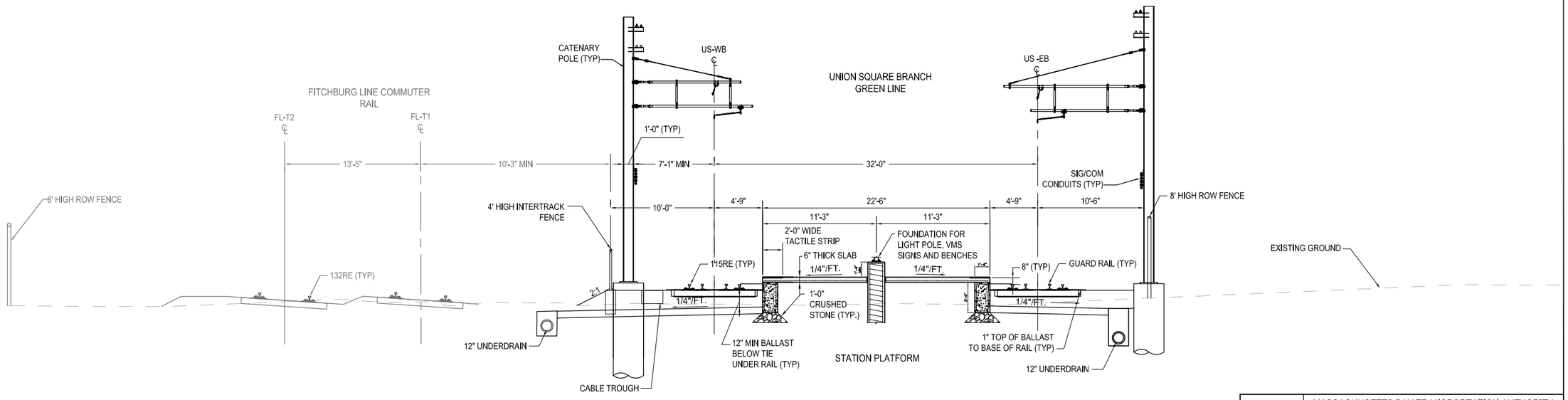
THE WALSH BARLETTA GRANITE
Joint Venture Team

TYPICAL SECTIONS
SHEET 1 OF 5

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-C-4001**



PLATFORM AT GRADE - 4 TRACK - MEDFORD BRANCH CORRIDOR



PLATFORM AT GRADE - 4 TRACK - UNION SQUARE BRANCH CORRIDOR

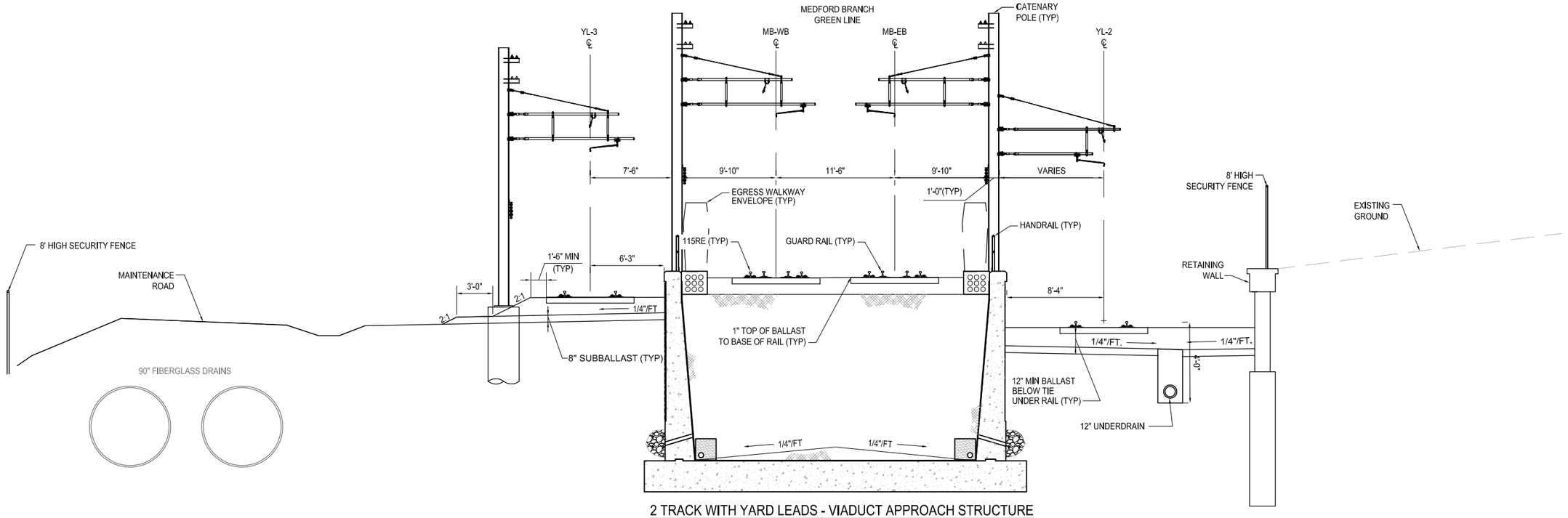
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

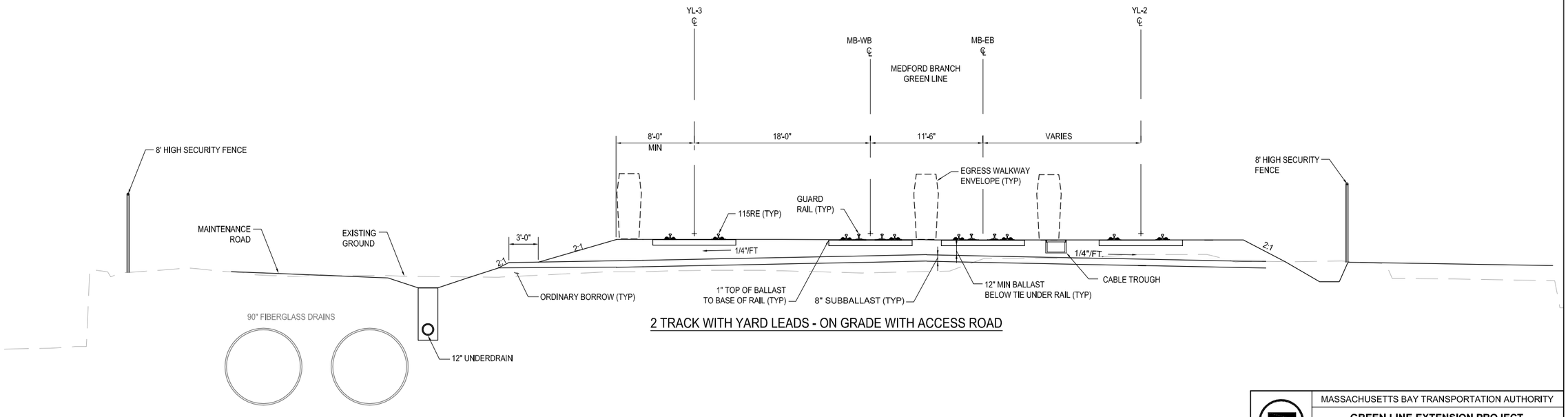
THE WALSH BARLETTA GRANITE
Joint Venture Team

TYPICAL SECTIONS
SHEET 2 OF 5

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-C-4002**



2 TRACK WITH YARD LEADS - VIADUCT APPROACH STRUCTURE



2 TRACK WITH YARD LEADS - ON GRADE WITH ACCESS ROAD

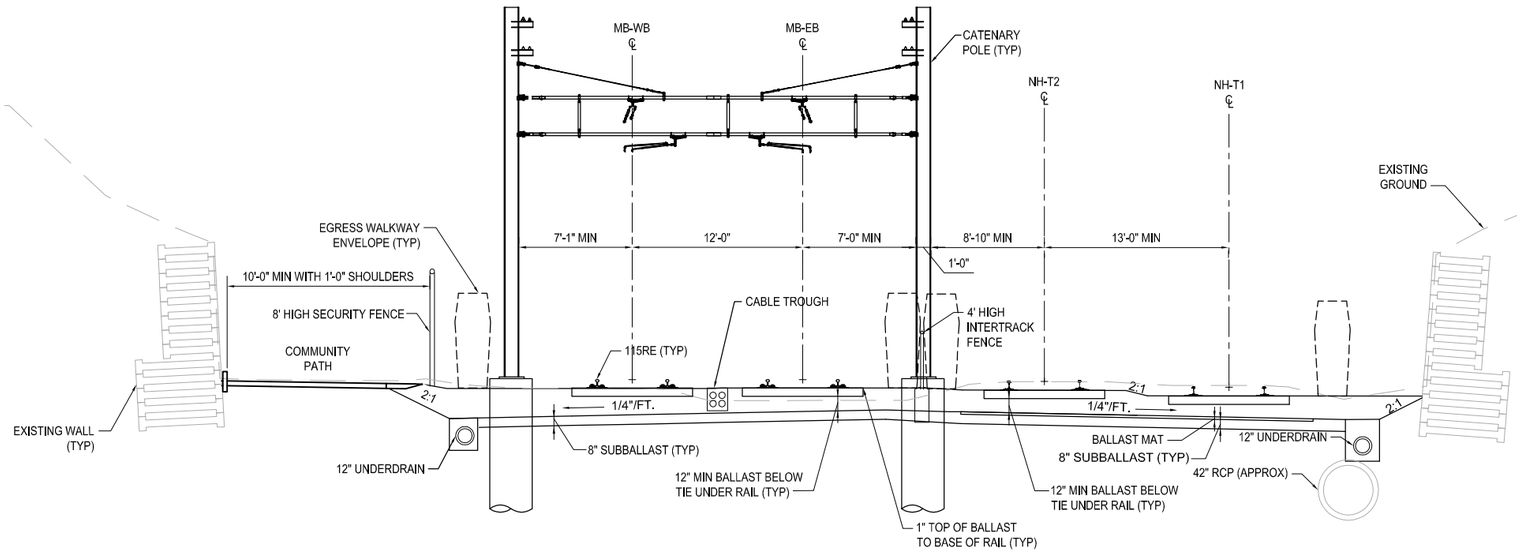
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

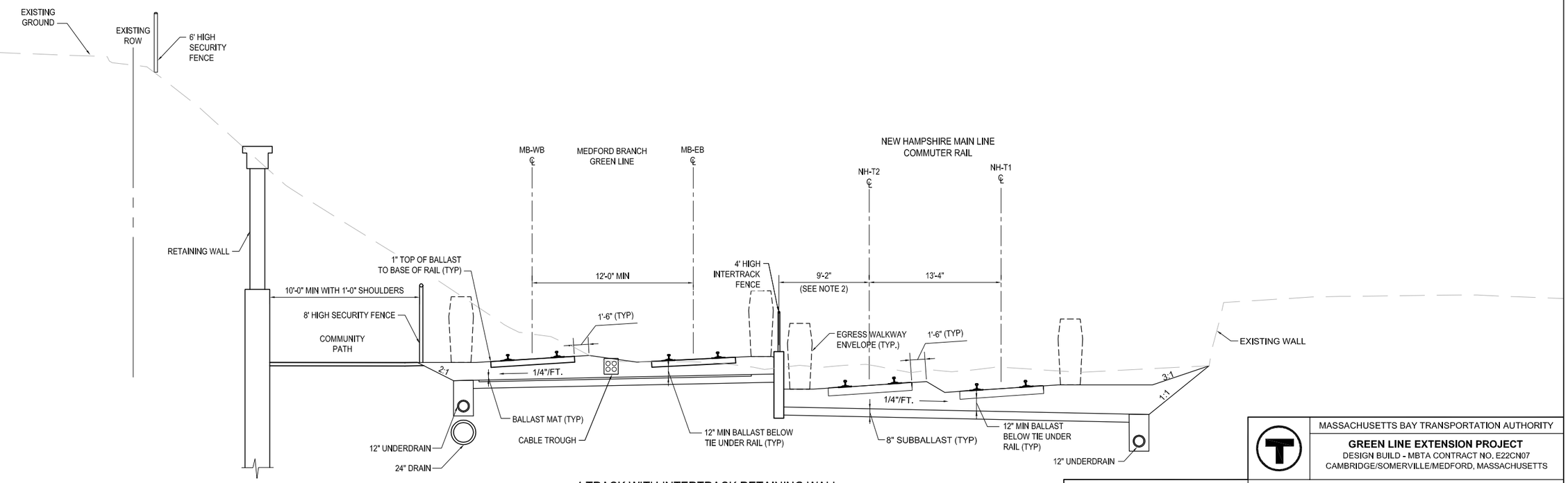
THE WALSH BARLETTA GRANITE
Joint Venture Team

TYPICAL SECTIONS
SHEET 3 OF 5

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-C-4003**



4 TRACK EXISTING WALL - PATH AT GRADE



4 TRACK WITH INTERTRACK RETAINING WALL

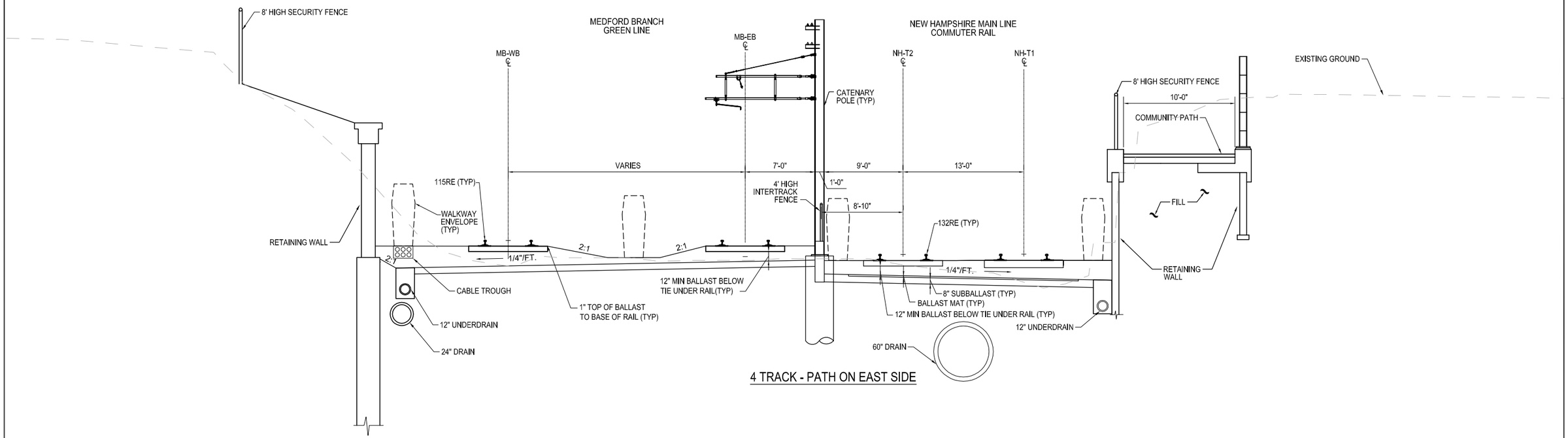
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

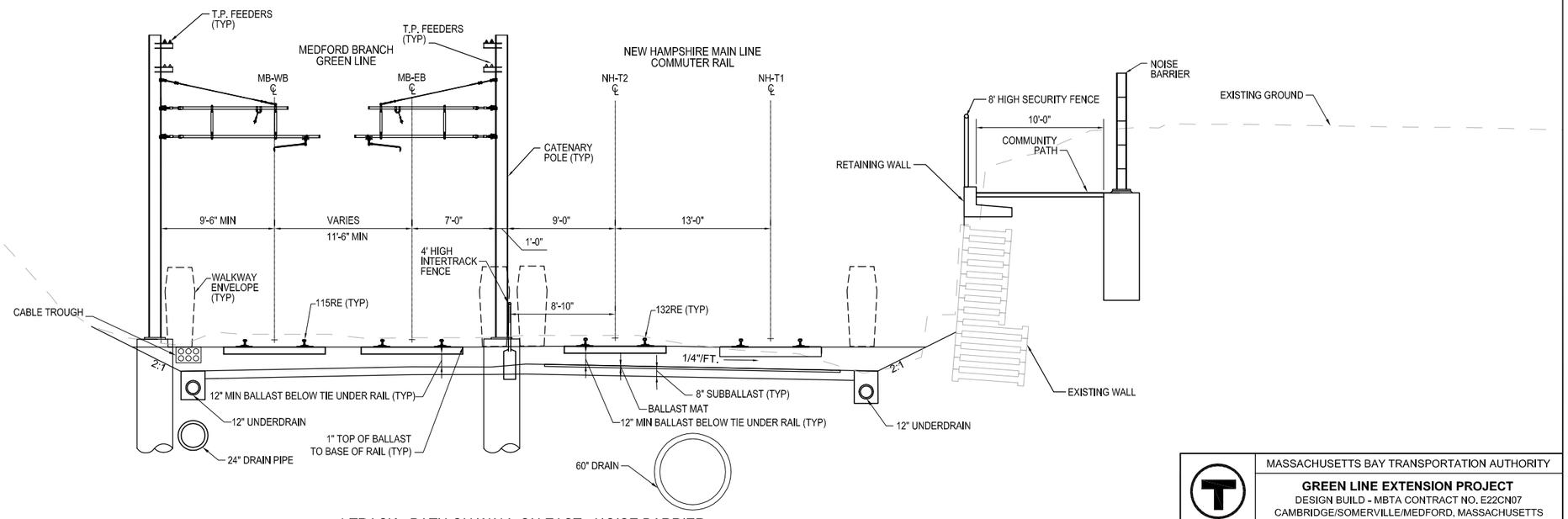
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

TYPICAL SECTIONS
SHEET 4 OF 5

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-C-4004**



4 TRACK - PATH ON EAST SIDE



4 TRACK - PATH ON WALL ON EAST - NOISE BARRIER

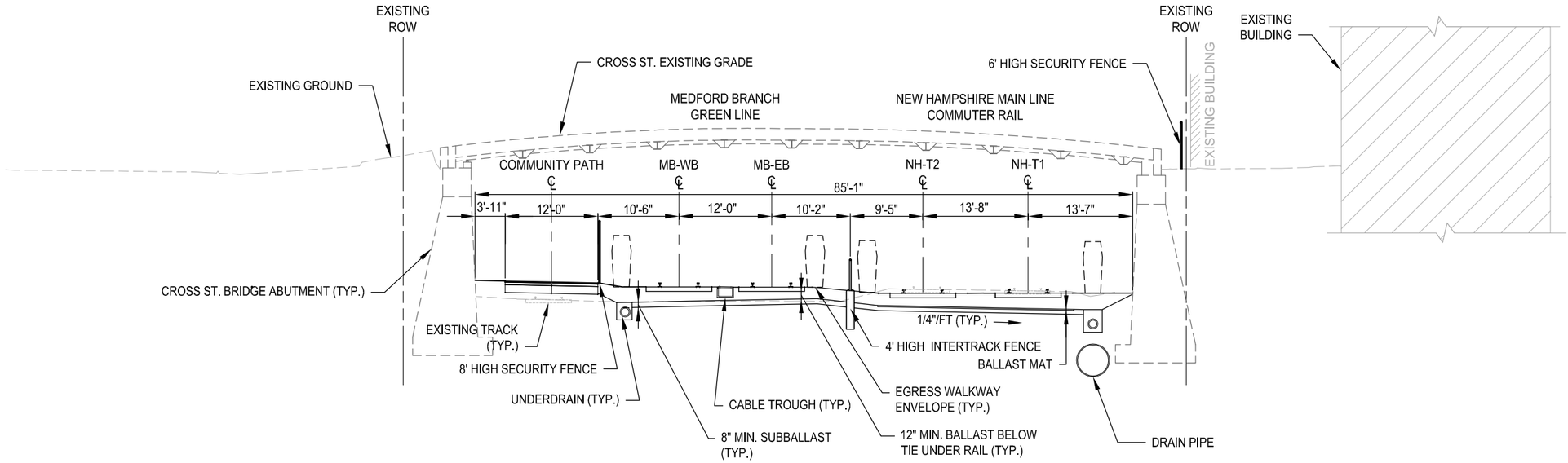
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

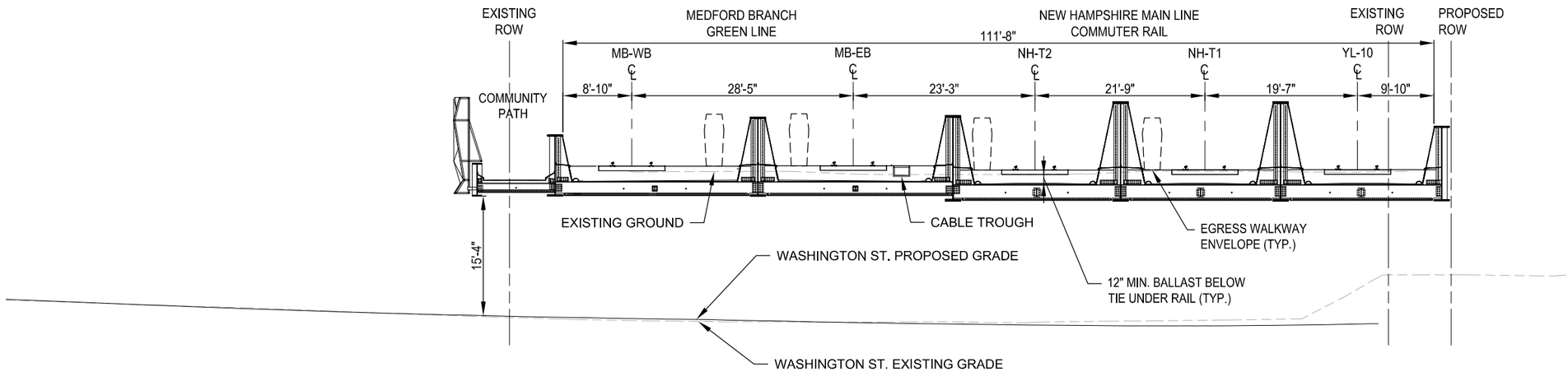
THE WALSH BARLETTA GRANITE
Joint Venture Team

TYPICAL SECTIONS
SHEET 5 OF 5

DATE: SEPT. 28, 2017 | SCALE: NO SCALE | SHEET **000-C-4005**



CROSS ST.
MB-WB STA. 246+00



WASHINGTON ST.
MB-WB STA. 237+40

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

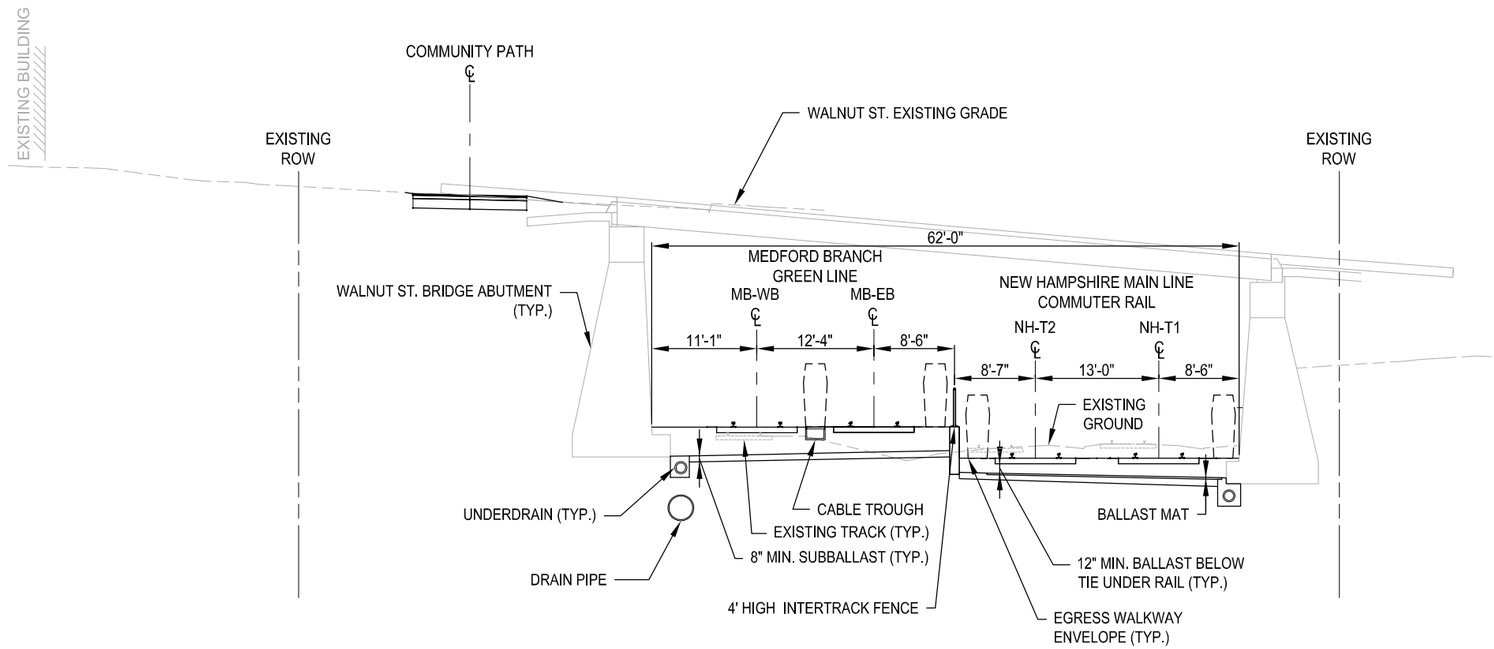
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

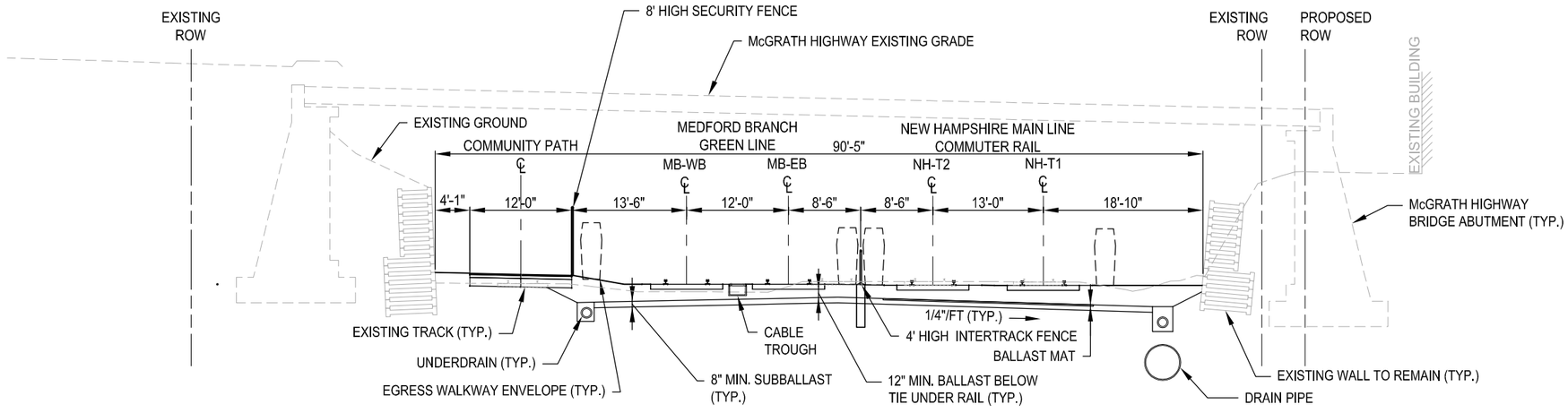
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 1 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **000-C-4101**



WALNUT ST.
MB-WB STA. 262+00



McGRATH HIGHWAY
MB-WB STA. 252+50

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

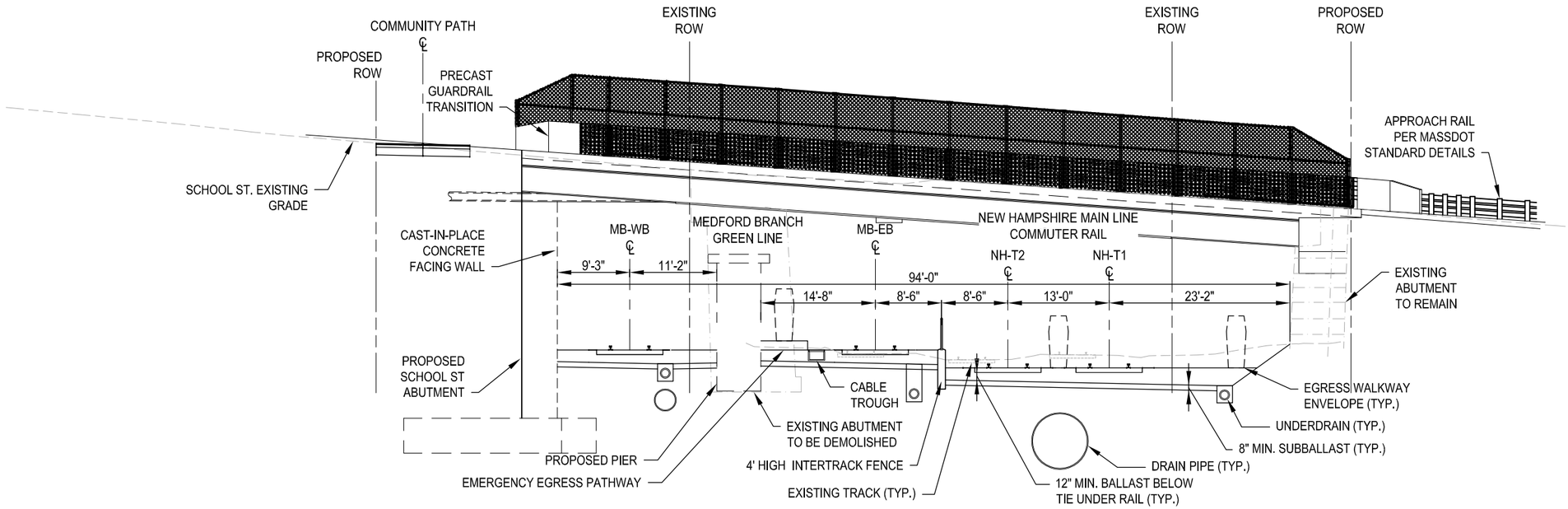
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

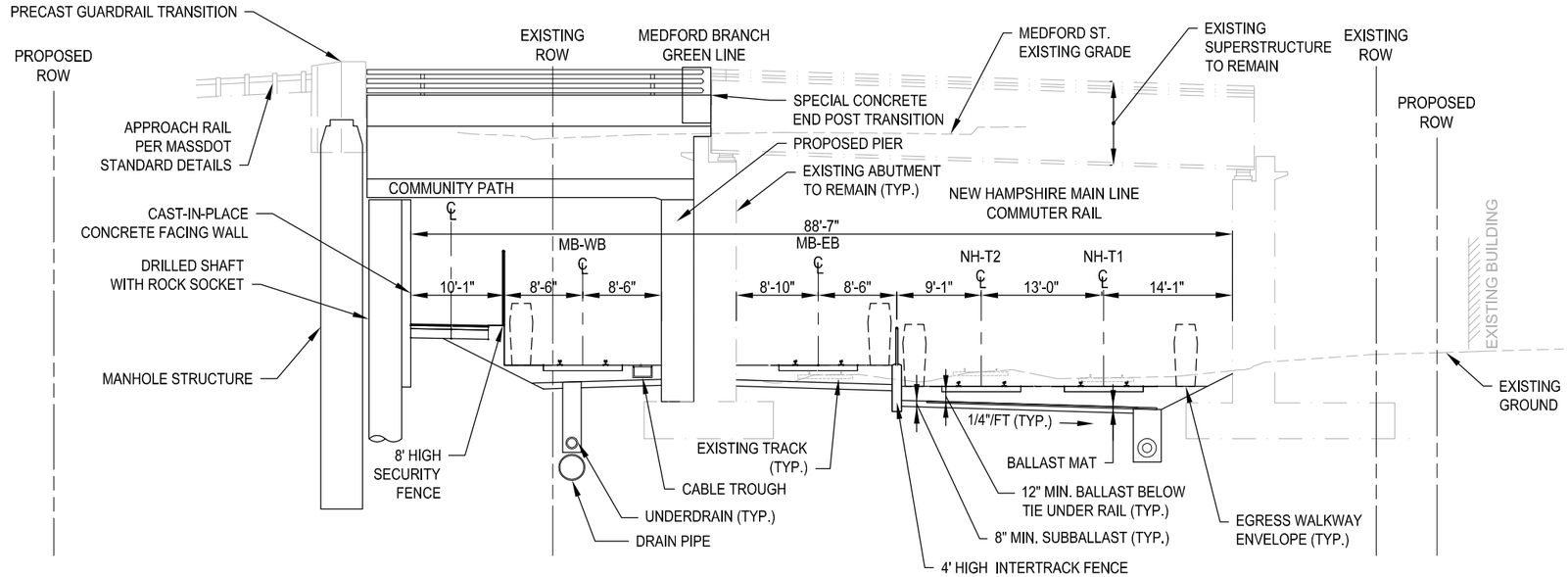
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 2 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-C-4102



SCHOOL ST.
MB-WB STA. 275+50



MEDFORD ST.
MB-WB STA. 268+00

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

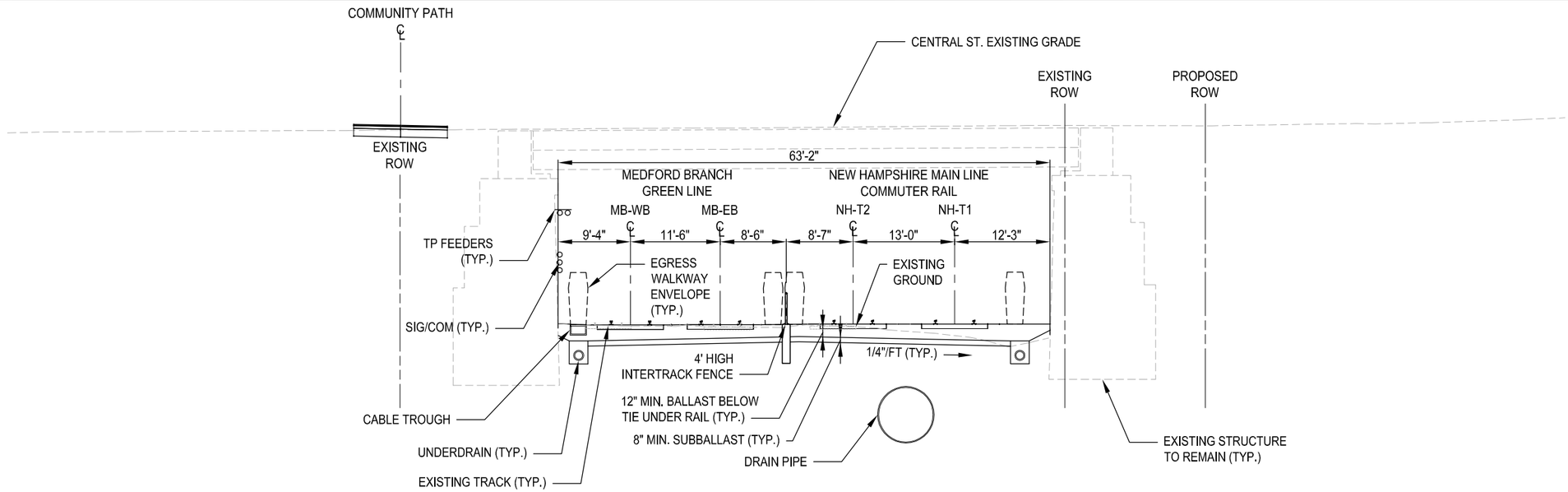
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

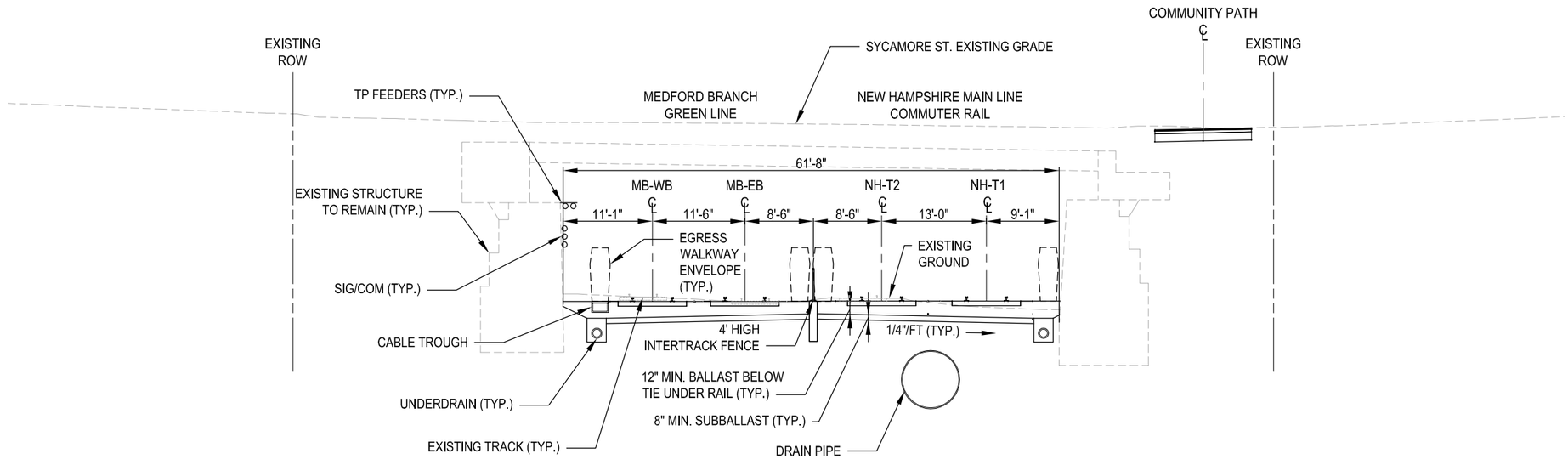
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 3 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **000-C-4103**



CENTRAL ST.
MB-WB STA. 289+60



SYCAMORE ST.
MB-WB STA. 285+00

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

4-201

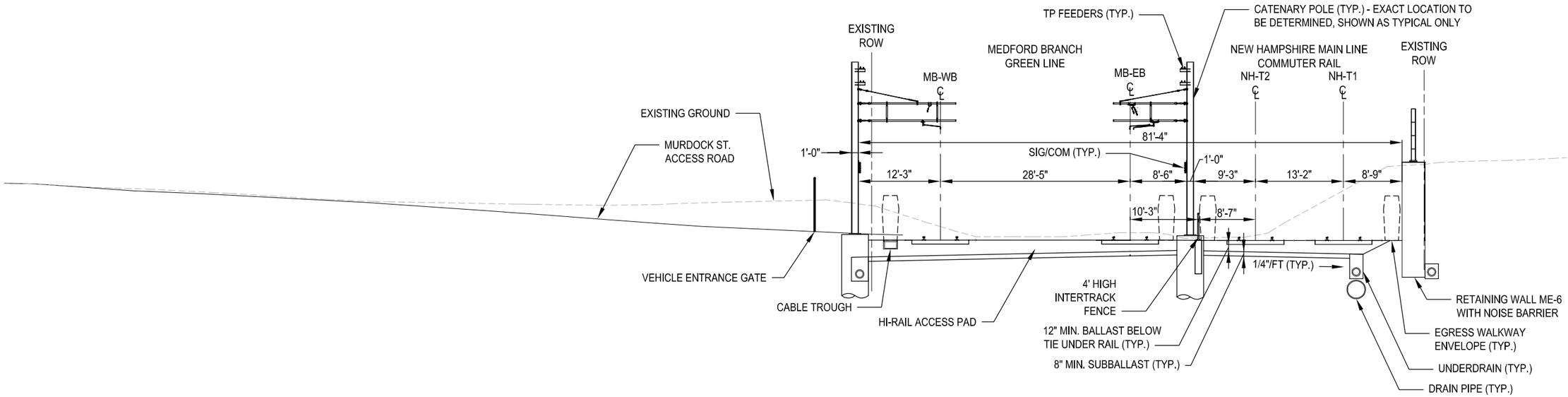
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

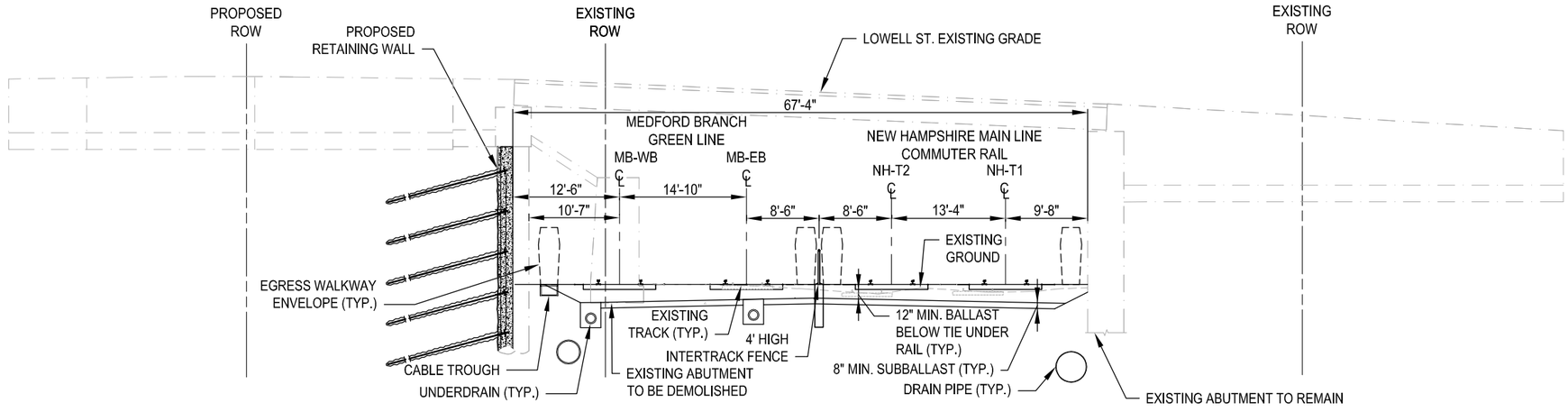
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 4 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-C-4104



MURDOCK ST. ACCESS ROAD / HI RAIL
MB-WB STA. 313+20



LOWELL ST.
MB-WB STA. 304+50

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

4-202

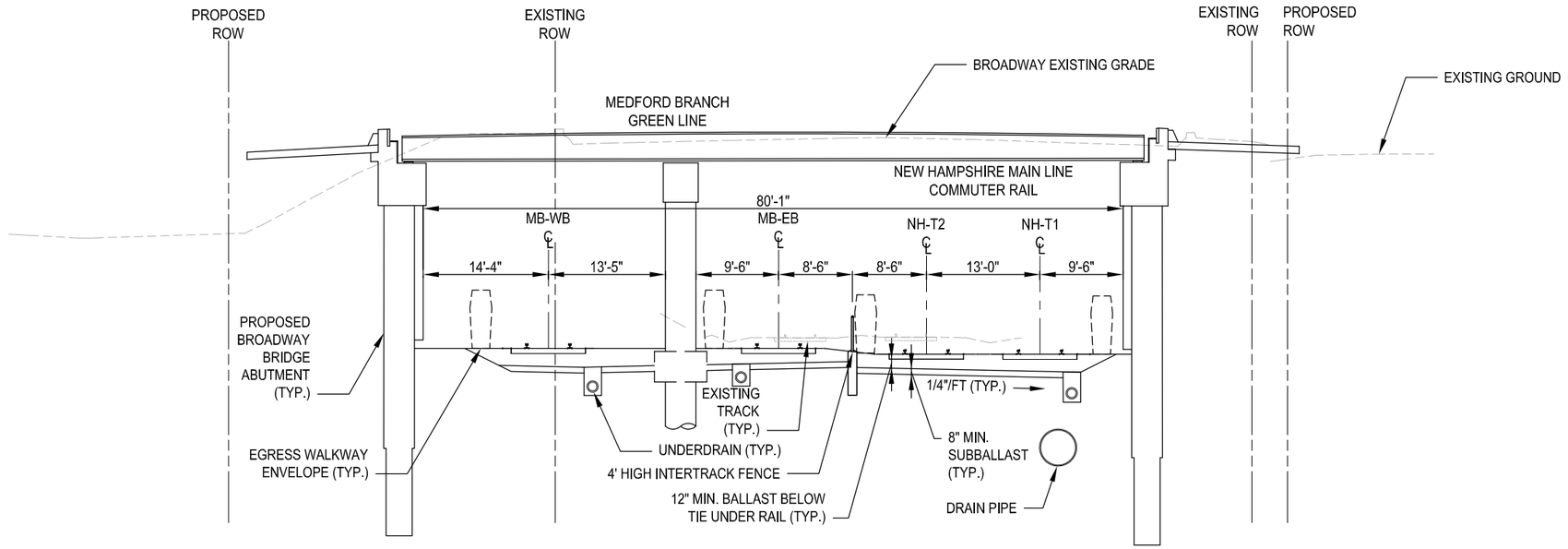
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

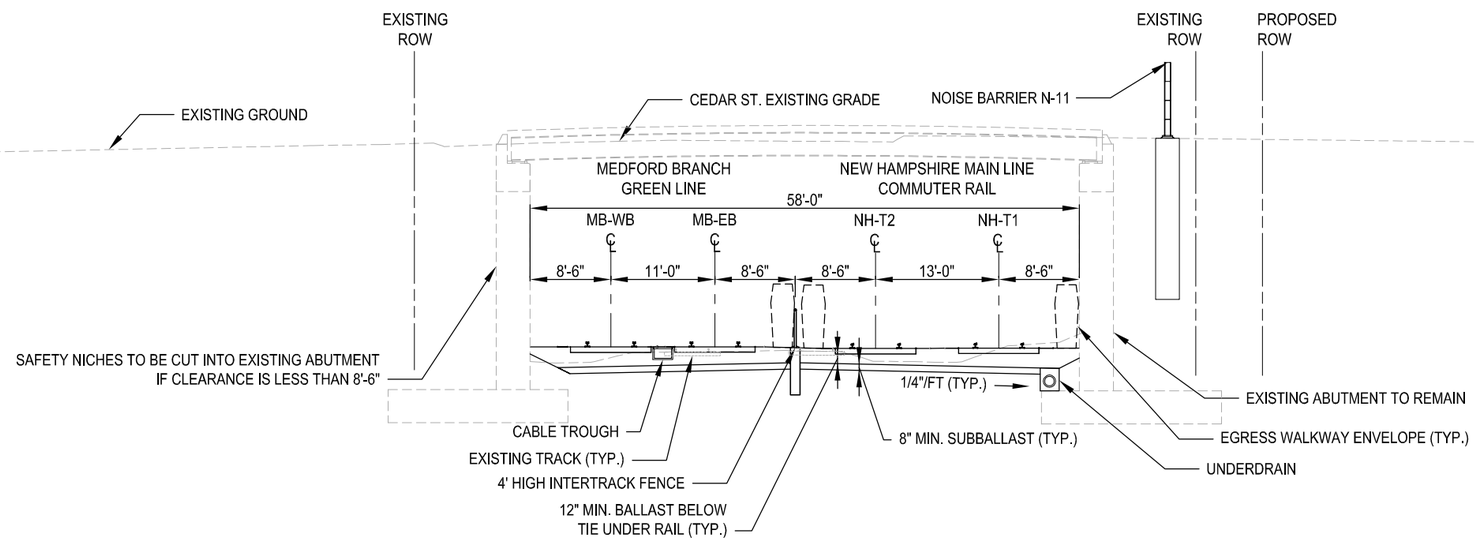
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 5 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-C-4105



BROADWAY
MB-WB STA. 330+00



CEDAR ST.
MB-WB STA. 321+00

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

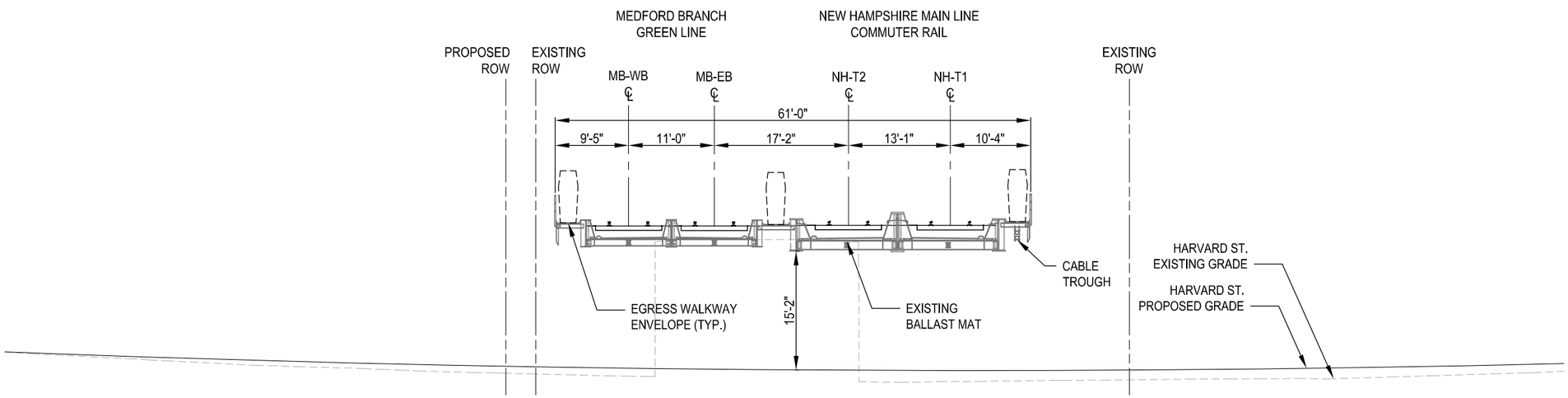
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

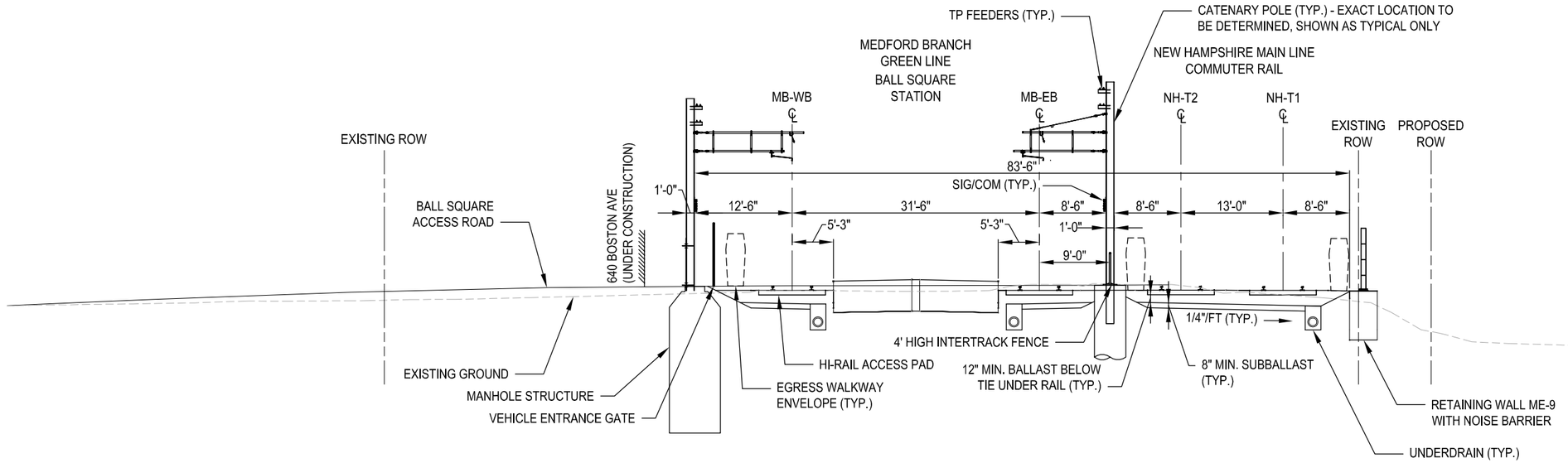
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 6 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-C-4106



HARVARD ST.
MB-WB STA. 345+50



BALL SQ. ACCESS ROAD / HI RAIL
MB-WB STA. 335+70

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

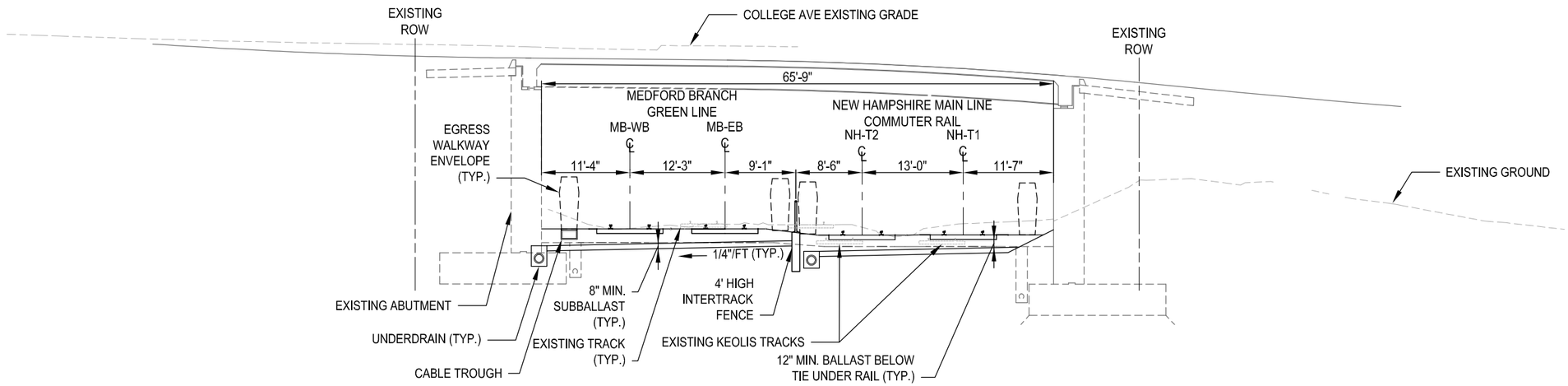
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

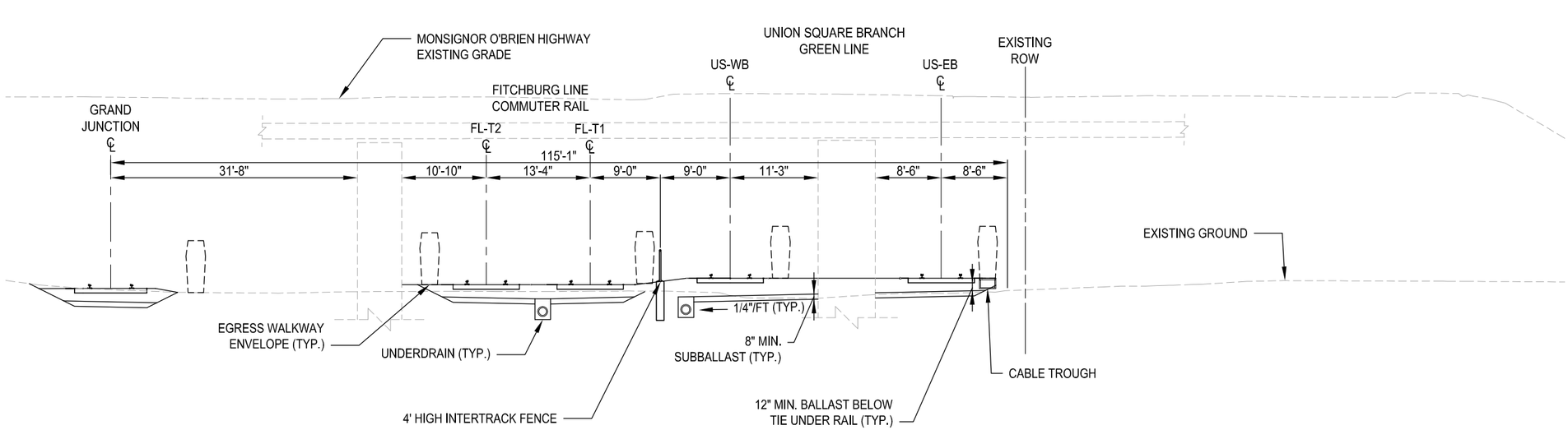
THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 7 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **000-C-4107**



COLLEGE AVE
MB-WB STA. 363+00



MONSIGNOR O'BRIEN HIGHWAY
US-EB STA. 20+00

HOR. SCALE IN FEET
8 0 8 16
8 0 8 16
VER. SCALE IN FEET

4-205

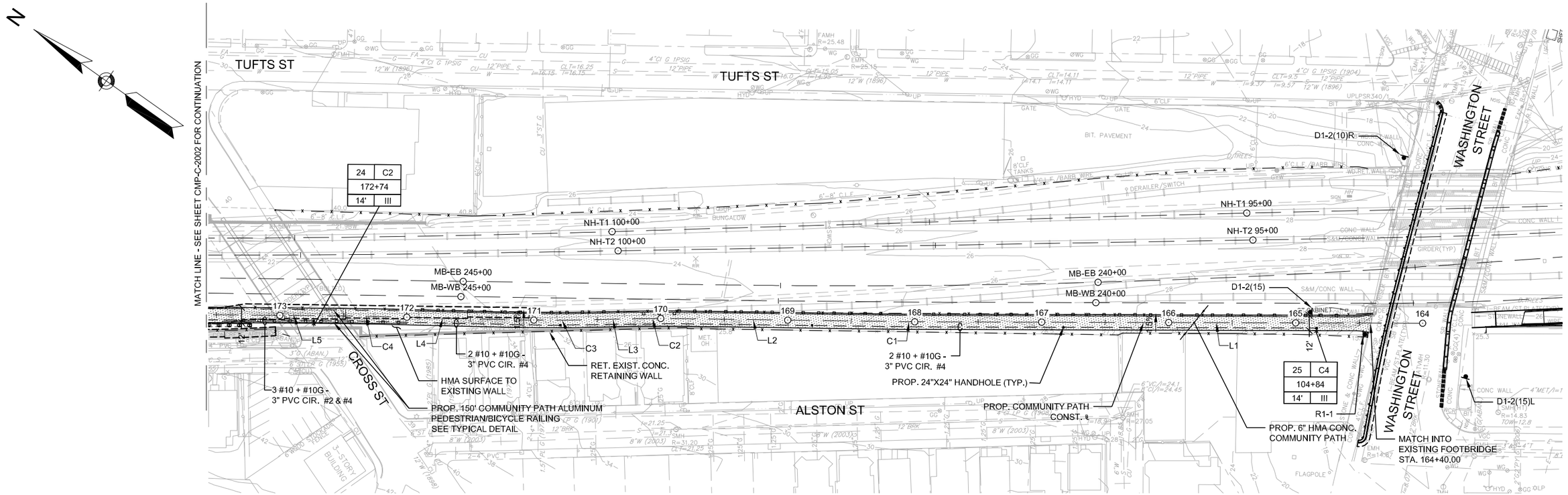
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

GUIDEWAY INTERSECTION TYPES
TYPICAL SECTIONS
SHEET 8 OF 8

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-C-4108



COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L1	164+00.00	2964056.9349	767421.5858		N35° 10' 36"W 399.13'	167+99.13	2964383.1771	767191.6455
C1	167+99.13	2964383.1771	767191.6455	R=1000.00' Δ=0°37'14" L=10.83' T=5.42'		168+09.97	2964392.0655	767185.4526
L2	168+09.97	2964392.0655	767185.4526		N34° 33' 22"W 178.55'	169+88.51	2964539.1117	767084.1786
C2	169+88.51	2964539.1117	767084.1786	R=1000.00' Δ=2°16'02" L=39.57' T=19.79'		170+28.08	2964571.2490	767061.0944
L3	170+28.08	2964571.2490	767061.0944		N36° 49' 24"W 19.04'	170+47.12	2964586.4895	767049.6834

COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
C3	170+47.12	2964586.4895	767049.6834	R=1500.00' Δ=2°54'34" L=76.17' T=38.09'		171+23.29	2964648.5958	767005.5980
L4	171+23.29	2964648.5958	767005.5980		N33° 54' 50"W 99.74'	172+23.03	2964731.3689	766949.9478
C4	172+23.03	2964731.3689	766949.9478	R=1500.00' Δ=0°55'57" L=24.41' T=12.21'		172+47.45	2964751.5183	766936.1615
L5	172+47.45	2964751.5183	766936.1615		N34° 50' 47"W 1011.43'	182+58.88	2965581.5888	766358.2504

KEY:

LUMINAIRE NUMBER — 1 | C1 — CIRCUIT NUMBER
00+00 — STATION
MOUTING HEIGHT — 14' | III — DISTRIBUTION TYPE

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

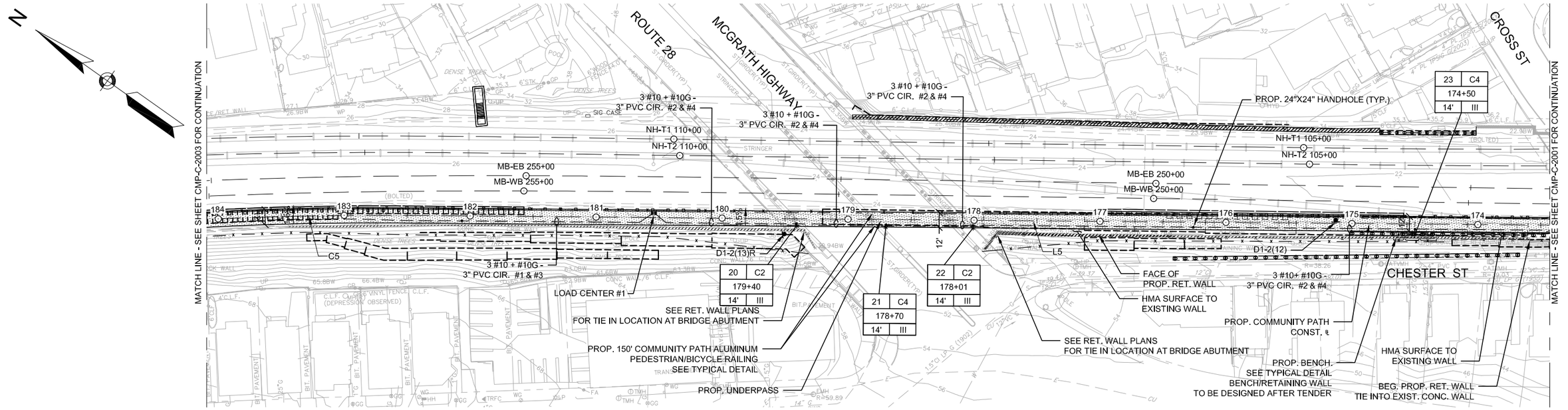
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

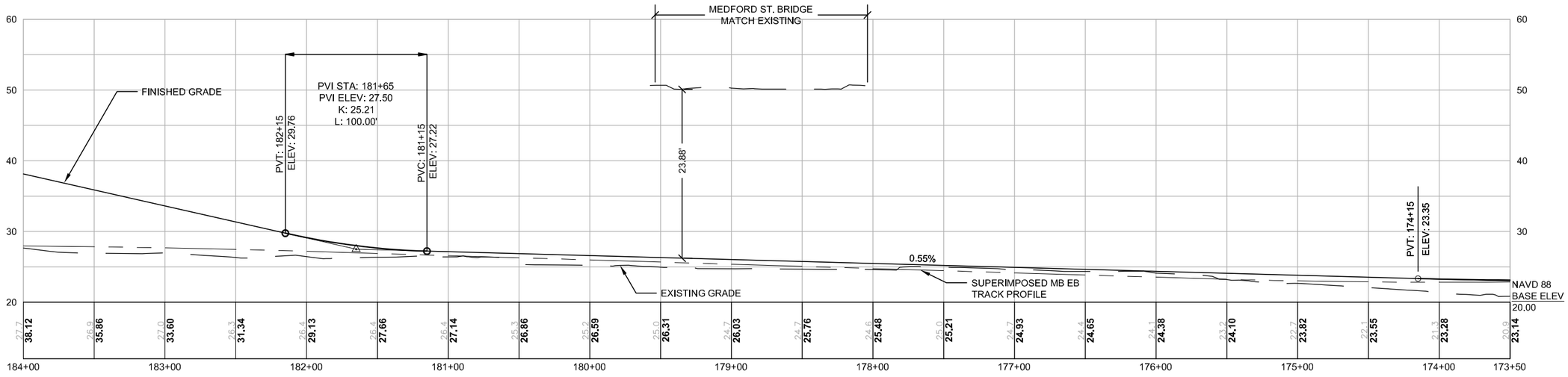
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

COMMUNITY PATH PLAN AND PROFILE SHEET 1 OF 7

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **CMP-C-2001**


N
MATCH LINE - SEE SHEET CMP-C-2003 FOR CONTINUATION
ROUTE 28
MCGRATH HIGHWAY
CROSS ST
CHESTER ST
MATCH LINE - SEE SHEET CMP-C-2001 FOR CONTINUATION
3 #10 + #10G - 3" PVC CIR. #2 & #4
NH-T1 110+00
NH-T2 110+00
MB-EB 255+00
MB-WB 255+00
3 #10 + #10G - 3" PVC CIR. #1 & #3
LOAD CENTER #1
C5
D1-2(13)R
SEE RET. WALL PLANS FOR TIE IN LOCATION AT BRIDGE ABUTMENT
PROP. 150' COMMUNITY PATH ALUMINUM PEDESTRIAN/BICYCLE RAILING SEE TYPICAL DETAIL
PROP. UNDERPASS
20 | C2 | 179+40 | 14' | III
21 | C4 | 178+70 | 14' | III
22 | C2 | 178+01 | 14' | III
23 | C4 | 174+50 | 14' | III
PROP. 24"X24" HANDHOLE (TYP.)
NH-T1 105+00
NH-T2 105+00
MB-EB 250+00
MB-WB 250+00
L5
FACE OF PROP. RET. WALL
HMA SURFACE TO EXISTING WALL
SEE RET. WALL PLANS FOR TIE IN LOCATION AT BRIDGE ABUTMENT
D1-2(12)
3 #10+ #10G - 3" PVC CIR. #2 & #4
PROP. COMMUNITY PATH CONST. ℄
PROP. BENCH. SEE TYPICAL DETAIL BENCH/RETAINING WALL TO BE DESIGNED AFTER TENDER
HMA SURFACE TO EXISTING WALL
BEG. PROP. RET. WALL TIE INTO EXIST. CONC. WALL



COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L5	172+47.45	2964751.5183	766936.1615		N34° 50' 47"W 1011.43'	182+58.88	2965581.5888	766358.2504
C5	182+58.88	2965581.5888	766358.2504	R=2500.00' Δ=11°40'06" L=509.13' T=255.45'		187+68.01	2965967.0213	766026.9537

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

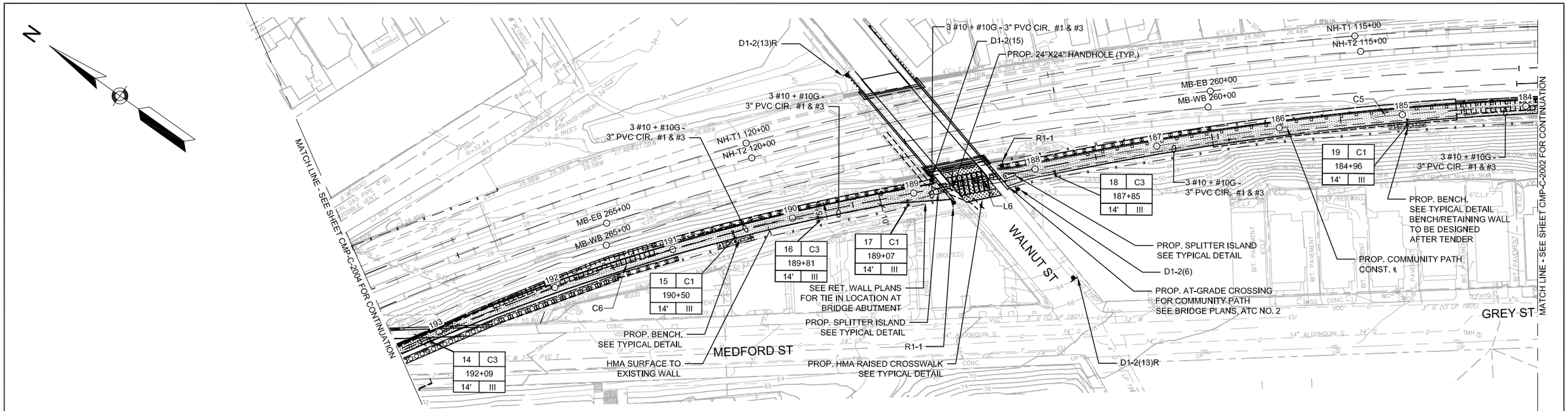
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

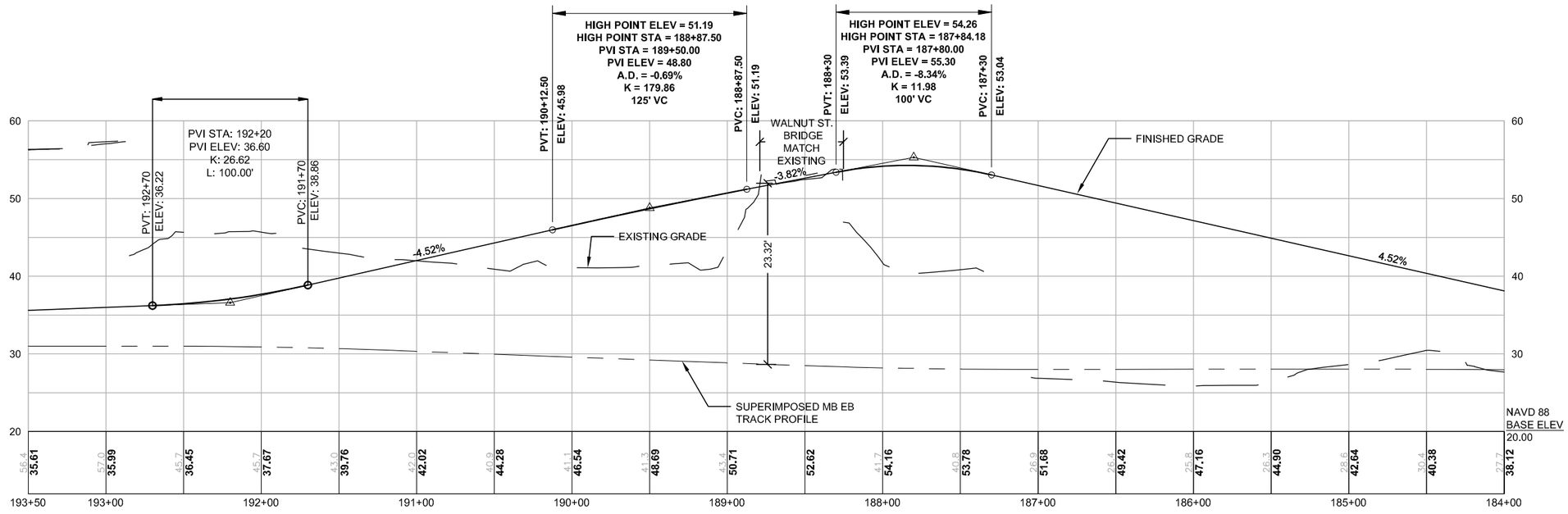
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

COMMUNITY PATH PLAN AND PROFILE SHEET 2 OF 7

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET CMP-C-2002


N
MATCH LINE - SEE SHEET CMP-C-2004 FOR CONTINUATION
D1-2(13)R
3 #10 + #10G - 3" PVC CIR. #1 & #3
NH-T1 120+00
NH-T2 120+00
MB-EB 265+00
MB-WB 265+00
C6
15 C1 190+50 14' III
16 C3 189+81 14' III
17 C1 189+07 14' III
18 C3 187+85 14' III
19 C1 184+96 14' III
14 C3 192+09 14' III
PROP. BENCH. SEE TYPICAL DETAIL
HMA SURFACE TO EXISTING WALL
MEDFORD ST
SEE RET. WALL PLANS FOR TIE IN LOCATION AT BRIDGE ABUTMENT
PROP. SPLITTER ISLAND SEE TYPICAL DETAIL
R1-1
PROP. HMA RAISED CROSSWALK SEE TYPICAL DETAIL
D1-2(15)
PROP. 24"X24" HANDHOLE (TYP.)
NH-T1 115+00
NH-T2 115+00
MB-EB 260+00
MB-WB 260+00
C5
L6
WALNUT ST
PROP. SPLITTER ISLAND SEE TYPICAL DETAIL
D1-2(6)
PROP. AT-GRADE CROSSING FOR COMMUNITY PATH SEE BRIDGE PLANS, ATC NO. 2
D1-2(13)R
PROP. BENCH. SEE TYPICAL DETAIL BENCH/RETAINING WALL TO BE DESIGNED AFTER TENDER
PROP. COMMUNITY PATH CONST. ℄
GREY ST
MATCH LINE - SEE SHEET CMP-C-2002 FOR CONTINUATION



COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
C5	182+58.88	2965581.5888	766358.2504	R=2500.00' Δ=11°40'06" L=509.13' T=255.45'		187+68.01	2965967.0213	766026.9537
L6	187+68.01	2965967.0213	766026.9537		N46° 30' 53"W 145.51'	189+13.52	2966067.1575	765921.3778
C6	189+13.52	2966067.1575	765921.3778	R=1790.00' Δ=14°39'09" L=457.77' T=230.14'		193+71.29	2966341.9433	765556.8182

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

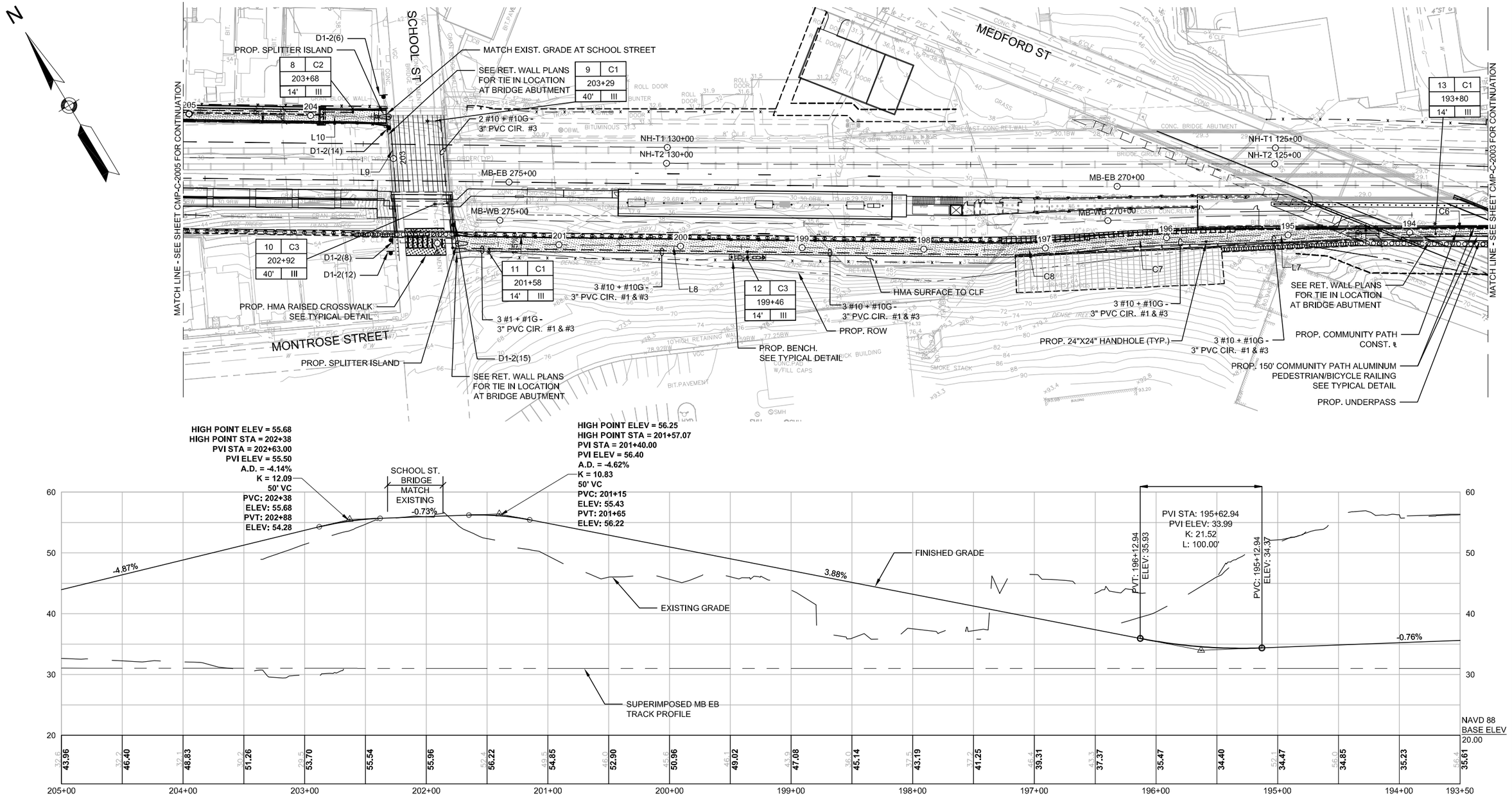
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

COMMUNITY PATH PLAN AND PROFILE SHEET 3 OF 7

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET CMP-C-2003



COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
C6	189+13.52	2966067.1575	765921.3778	R=1790.00' Δ=14°39'09" L=457.77' T=230.14'		193+71.29	2966341.9433	765556.8182
L7	193+71.29	2966341.9433	765556.8182		N60° 19' 09"W 209.02'	195+80.31	2966445.4434	765375.2218
C7	195+80.31	2966445.4434	765375.2218	R=1000.00' Δ=5°43'26" L=99.90' T=49.99'		196+80.21	2966490.4979	765286.1016
C8	196+80.21	2966490.4979	765286.1015	R=500.00' Δ=7°35'40" L=66.27' T=33.19'		197+46.48	2966521.3371	765227.4956
L8	197+46.48	2966521.3371	765227.4956		N58° 26' 56"W 484.03'	202+30.52	2966774.6117	764815.0156

COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L9	202+30.52	2966774.6117	764815.0156		N26° 19' 52"E 104.02'	203+34.54	2966867.8416	764861.1556
L10	203+34.54	2966867.8416	764861.1556		N58° 20' 21"W 882.76'	212+17.30	2967331.1901	764109.7798

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

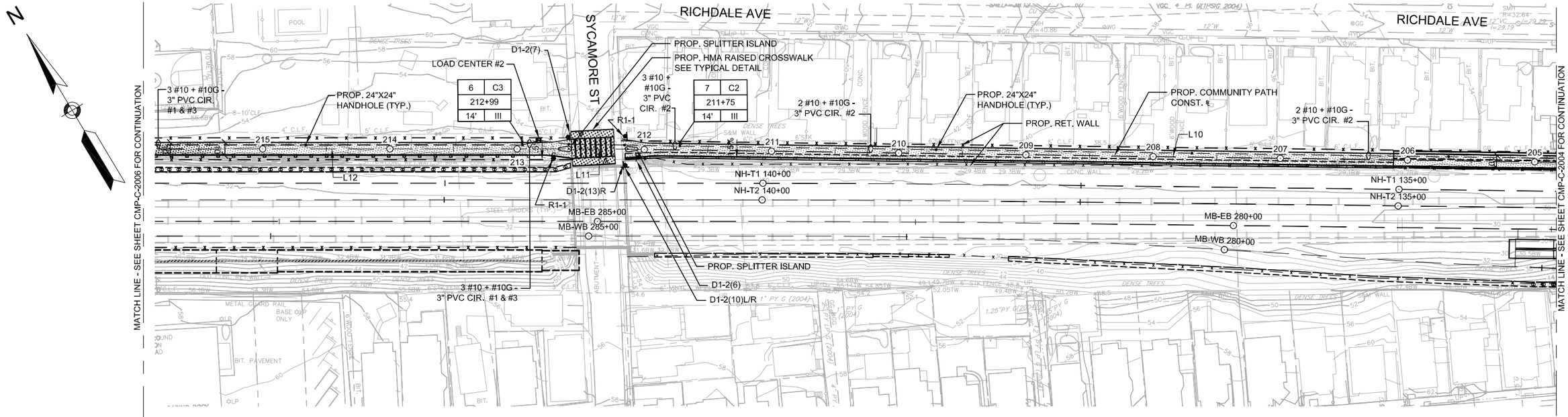
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

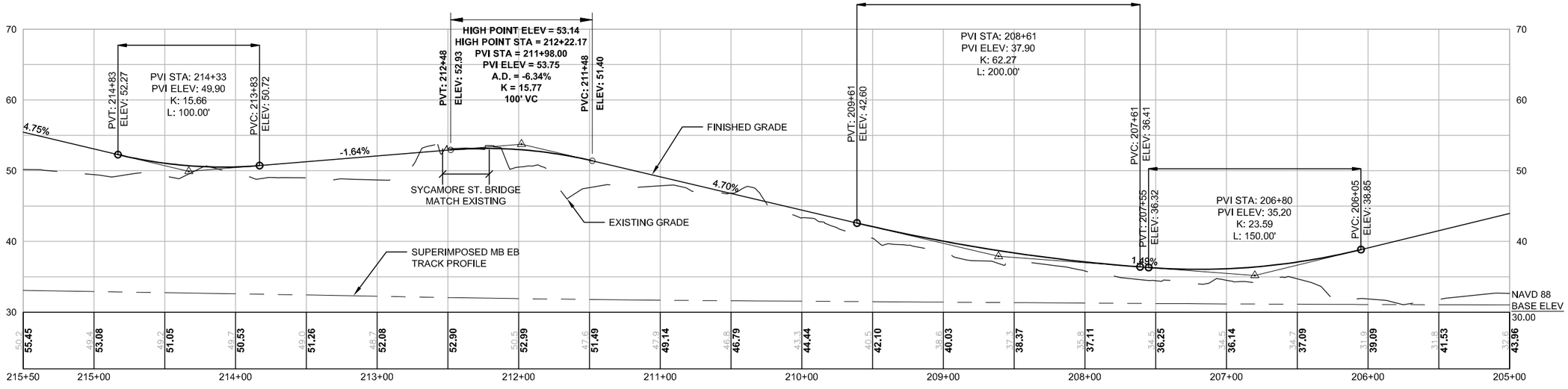
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

COMMUNITY PATH PLAN AND PROFILE SHEET 4 OF 7

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **CMP-C-2004**





COMMUNITY PATH CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L10	203+34.54	2966867.8416	764861.1556		N58° 20' 21"W 882.76'	212+17.30	2967331.1901	764109.7798
L11	212+17.30	2967331.1901	764109.7798		N58° 52' 07"W 40.08'	212+57.38	2967351.9138	764075.4681
L12	212+57.38	2967351.9138	764075.4681		N59° 08' 22"W 428.84'	216+86.22	2967571.8862	763707.3481

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

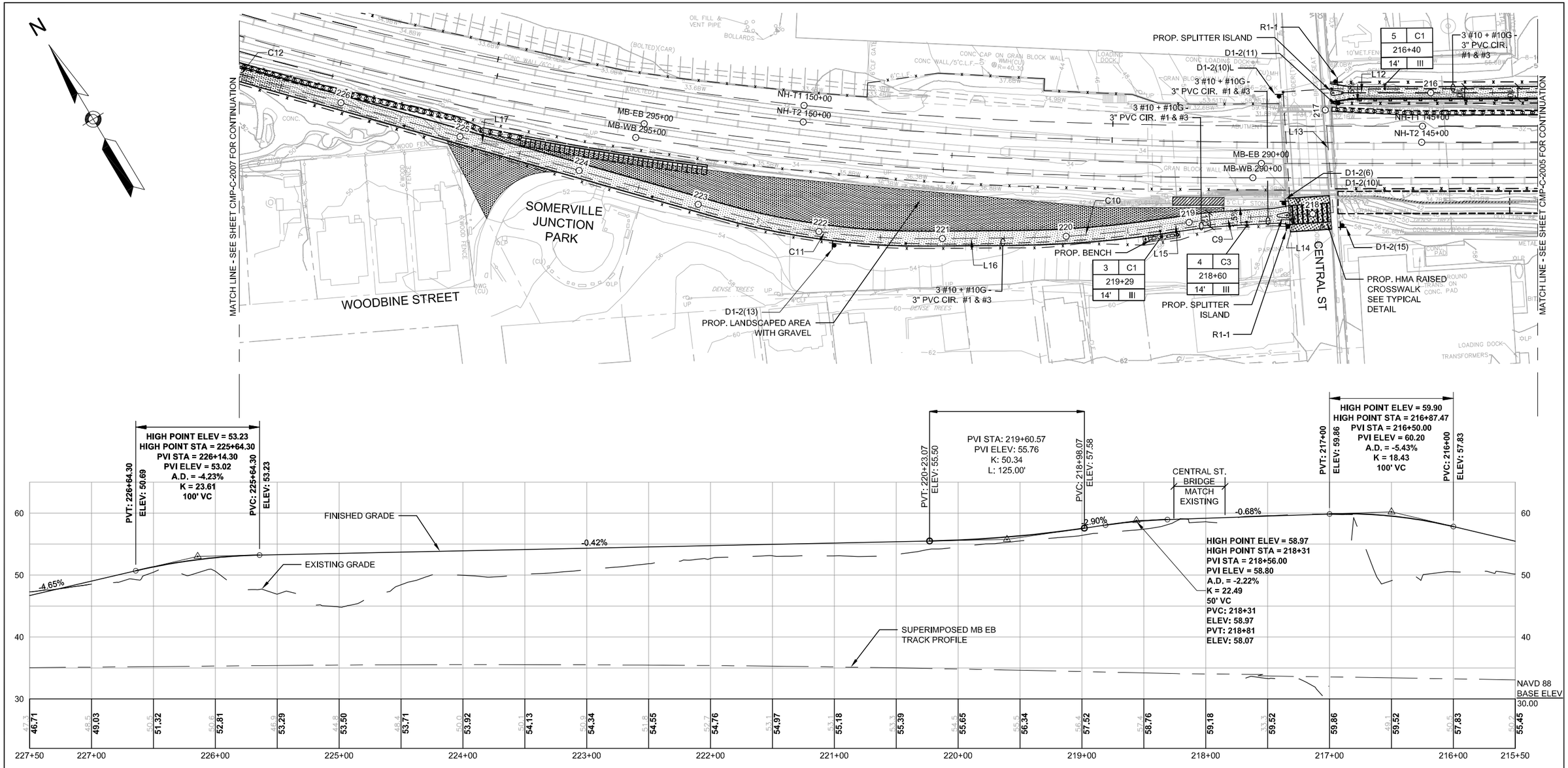
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

COMMUNITY PATH PLAN AND PROFILE SHEET 5 OF 7

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **CMP-C-2005**



COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L12	212+57.38	2967351.9138	764075.4681		N59° 08' 22"W 428.84'	216+86.22	2967571.8862	763707.3481
L13	216+86.22	2967571.8862	763707.3481		S26° 29' 19"W 96.99'	217+83.20	2967485.0811	763664.0902
L14	217+83.20	2967485.0811	763664.0902		N62° 05' 07"W 76.66'	218+59.86	2967520.9706	763596.3490
C9	218+59.86	2967520.9706	763596.3490	R=500.00' Δ=5°36'09" L=48.89' T=24.47'		219+08.76	2967541.7127	763552.0965
L15	219+08.76	2967541.7127	763552.0965		N67° 41' 16"W 11.23'	219+19.99	2967545.9764	763541.7067
C10	219+19.99	2967545.9764	763541.7067	R=850.00' Δ=8°12'45" L=121.83' T=61.02'		220+41.82	2967600.1371	763432.6889

COMMUNITY PATH CONSTRUCTION BASELINE DATA								
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L16	220+41.82	2967600.1371	763432.6889		N59° 28' 31"W 69.84'	221+11.66	2967635.6096	763372.5278
C11	221+11.66	2967635.6096	763372.5278	R=600.00' Δ=16°19'31" L=170.96' T=86.06'		222+82.62	2967742.1093	763239.5341
L17	222+82.62	2967742.1093	763239.5341		N43° 09' 00"W 397.78'	226+80.40	2968032.3157	762967.4882
C12	226+80.40	2968032.3157	762967.4882	R=1000.00' Δ=0°34'05" L=9.92' T=4.96'		226+90.32	2968039.5164	762960.6707

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

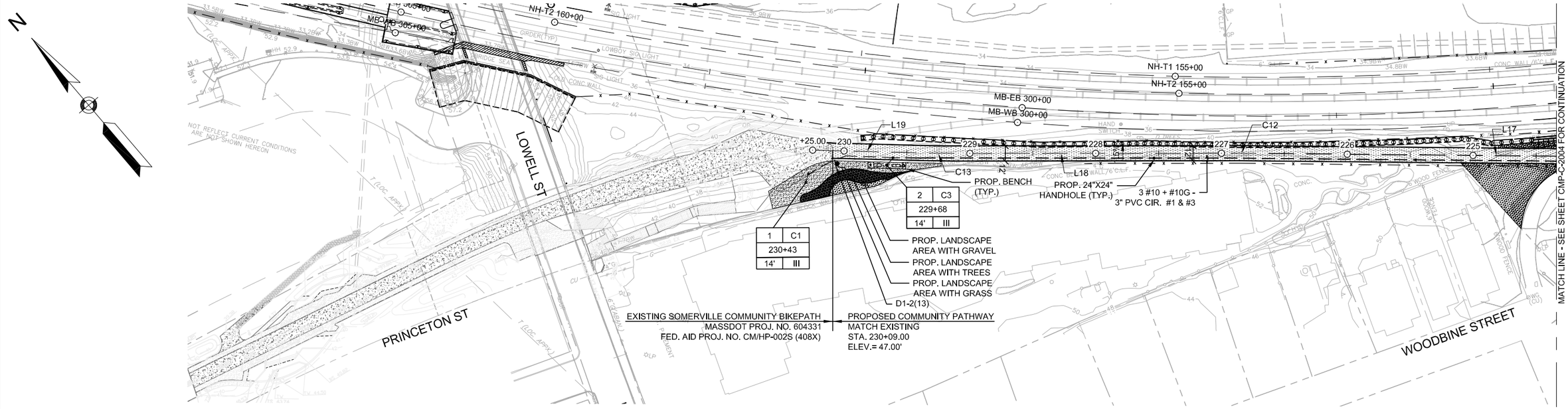
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

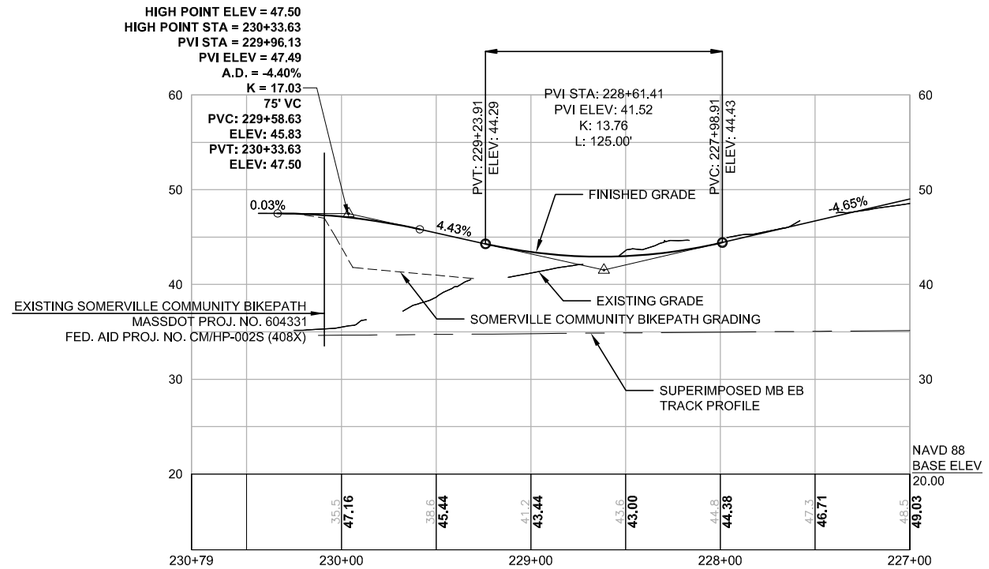
GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

COMMUNITY PATH PLAN AND PROFILE SHEET 6 OF 7

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **CMP-C-2006**





COMMUNITY PATH CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L17	222+82.62	2967742.1093	763239.5341		N43° 09' 00"W 397.78'	226+80.40	2968032.3157	762967.4882
C12	226+80.40	2968032.3157	762967.4882	R=1000.00' Δ=0°34'05" L=9.92' T=4.96'		226+90.32	2968039.5164	762960.6707
L18	226+90.32	2968039.5164	762960.6707		N43° 43' 05"W 221.30'	229+11.61	2968199.4602	762807.7281
C13	229+11.61	2968199.4602	762807.7281	R=1000.00' Δ=1°32'38" L=26.95' T=13.47'		229+38.56	2968219.1839	762789.3700
L19	229+38.56	2968219.1839	762789.3700		N42° 10' 27"W 86.44'	230+25.00	2968283.2447	762731.3356

HOR. SCALE IN FEET
20 0 20 40
VER. SCALE IN FEET
4 0 4 8

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

COMMUNITY PATH PLAN AND PROFILE SHEET 7 OF 7

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET CMP-C-2007

GILMAN ST

3" G (CI 1PSIG 1902)

RETAIN EXIST. 48" WATER MAIN
NO IMPACT TO
WALNUT STREET BRIDGE
DUE TO ATC NO. 2

TELEPHONE MOUNTED
TO NEW POLE

R&D EXIST. STORM
UNDERDRAIN

℄ NH-T1 TRACK

℄ NH-T2 TRACK

PROPOSED DRAINAGE SYSTEM

PROP. 1-2" COMMUNICATION
CONDUIT & 1-2" ELECTRICAL
CONDUIT FROM SIH TO
EMERGENCY EGRESS GATE

TELEPHONE MOUNTED
TO NEW POLE

NH 120+00

NH 115+00

MB 260+00

SC

DENSE TREES

D. TREES

6' C.L.F.

6' STK. FENCE / STREET WALL

S&M WALL

CONC. WALL

WOOD STOCKADE FENCE ON WALL

6' VINYL

℄ MB-EB TRACK

℄ MB-WB TRACK

R&D EXIST. UP

R&D EXIST. STORM
UNDERDRAIN

COMMUNITY PATH AT-GRADE
WITH WALNUT ST. BRIDGE
ATC NO. 2

APPROX. LOCATION
EASEMENT

BIT. PAVEMENT

BOX

MH(INACC)
R=54.36
(BOLTED)

MH
R=54.48

CONC.

WALNUT ST

MEDFORD ST

TMH
R=60.67

14" G

1.5" G (1901)

CONC.BLOCK WALL

CONC. WALL

WIRE

5' C.L.F.

6' C.L.F. RET. WALL

PAVEMENT

HOR. SCALE IN FEET
20 0 20 40

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH & NH MAINLINE UTILITY PLAN
WALNUT STREET BRIDGE ATC NO. 2

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET 000-C-2010

WBG